ADRIANO AFONSO SPIELMANN

Estudos taxonômicos em *Parmotrema* s.l. (*Parmeliaceae*, *Ascomycota* liquenizados) com ácido salazínico

Tese apresentada ao Instituto de Botânica da Secretaria do Meio Ambiente, como parte dos requisitos exigidos para a obtenção do título de DOUTOR em BIODIVERSIDADE VEGETAL E MEIO AMBIENTE, na Área de Concentração de Plantas Avasculares e Fungos.

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"*Gostar de algo é melhor do que*
meramente conhecê-lo,
e encontrar alegria nesse algo
é melhor do que meramente gostar dele".

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Adriano Afonso Spielmann

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RESUMO

As espécies do gênero *Parmotrema* s.l. com ácido salazínico são revisadas, com base especialmente nos tipos das espécies aceitas e de seus sinônimos. São fornecidas chave e descrições para 61 espécies, incluindo sinonímia, química, distribuição e discussão das afinidades taxonômicas de cada táxon.

Foi utilizada metodologia clássica em Liquenologia, contando com uso de microscópio óptico e estereoscópico, bem como ferramentas químicas para identificação das substâncias de importância taxonômica, tais como testes de coloração, lâmpada UV, cromatografia em camada delgada (TLC) e, para várias espécies, cromatografia líquida de alta eficiência (CLAE).

Duas espécies novas são descritas: *Parmotrema austromaculatum* e *P. bifidum*. Uma nova combinação dentro de *Parmelinella* foi proposta, *P. afrocetrata* (Elix, Fischer & Killmann) Marcelli & Spielmann, e 14 novas combinações em *Parmotrema*: *P. acanthifolium* (Pers.) Spielmann & Marcelli, *P. concors* (Kremp.) Spielmann & Marcelli, *P. foliolosum* (C.W. Dodge) Spielmann & Marcelli, *P. granularis* (Asahina) Spielmann & Marcelli, *P. herrei* (Zahlbr.) Spielmann & Marcelli, *P. livido-tesselatum* (Hue) Spielmann & Marcelli, *P. magnum* (Lynge) Spielmann & Marcelli, *P. maximum* (Hue) Spielmann & Marcelli, *P. nudum* (Hue) Spielmann & Marcelli, *P. petropoliense* (Zahlbr.) Spielmann & Marcelli, *P. radiatum* (Lynge) Spielmann & Marcelli, *P. reterimulosum* (Zahlbr.) Spielmann & Marcelli, *P. sieberi* (C.W. Dodge) Spielmann & Marcelli e *P. warmingii* (Vainio) Spielmann & Marcelli. Doze táxons permanecem sem *status* definido e estão dentro dos *Nomina inquirenda*.

ABSTRACT

Species of *Parmotrema* s.l. with salazinic acid are revised, based on the types of the accepted species as well as his synonyms. A key and descriptions for the 61 species are given, and the synonymy, chemistry, distribution and taxonomic affinities of each species are discussed.

Classical methods in Lichenology were employed, using stereomicroscope and optical microscopy for the observations, and spot tests, TLC and HPLC for the chemical analysis.

Two new species are described: *Parmotrema austromaculatum* e *P. bifidum*. One new combination in *Parmelinella* was made, *P. afrocetrata* (Elix, Fischer & Killmann) Marcelli & Spielmann, and 14 new combinations in *Parmotrema*: *P. acanthifolium* (Pers.) Spielmann & Marcelli, *P. concors* (Kremp.) Spielmann & Marcelli, *P. foliolosum* (C.W. Dodge) Spielmann & Marcelli, *P. granularis* (Asahina) Spielmann & Marcelli, *P. herrei* (Zahlbr.) Spielmann & Marcelli, *P. livido-tesselatum* (Hue) Spielmann & Marcelli, *P. magnum* (Lynge) Spielmann & Marcelli, *P. maximum* (Hue) Spielmann & Marcelli, *P. nudum* (Hue) Spielmann & Marcelli, *P. petropoliense* (Zahlbr.) Spielmann & Marcelli, *P. radiatum* (Lynge) Spielmann & Marcelli, *P. reterimulosum* (Zahlbr.) Spielmann & Marcelli, *P. sieberi* (C.W. Dodge) Spielmann & Marcelli and *P. angustatum* (Vainio) Spielmann & Marcelli. Twelve taxa remain without definite status and are included in the *Nomina inquirenda*.

Introdução

O levantamento de *Parmeliaceae* na região central do Rio grande do Sul (Spielmann 2005) demonstrou que há um grupo cosmopolita de fungos liquenizados com problemas taxonômicos interessantes e complexos formado por espécies dos gêneros *Canomaculina*, *Parmotrema* e *Rimelia* com ácido salazínico na medula.

Entre o período da defesa do mestrado e início do projeto de doutorado (em agosto de 2005), foi proposta a sinonimização dos gêneros *Canomaculina* e *Rimelia* sob *Parmotrema* (Blanco *et al.* 2005), que são designados atualmente como parmotremóides ou *Parmotrema* s.l.

Os problemas taxonômicos e nomenclaturais englobam os tipos de todos os nomes existentes, incluindo seus sinônimos. Assim, este é basicamente um estudo de materiais-tipo, às vezes apoiado em coletas recentes, embora sem ter o objetivo de ser um trabalho florístico.

Histórico de *Parmotrema* s.l. com ácido salazínico

Os nomes novos, nomes inválidos, novas combinações e proposições de sinônimos estão ordenados cronologicamente na Tabela 1.

No breve histórico que se segue, a ênfase é colocada principalmente naqueles autores que propuseram nomes ou combinações novas, bem como descreveram novas espécies. Não são incluídos os trabalhos de flora, listagens ou que comentam espécies publicadas validamente em outro local.

Parmotrema Massalongo

A história dos liquens parmotremóides inicia com a proposição do gênero *Parmotrema* (Massalongo 1860). Neste trabalho, Massalongo utilizou como caráter primordial para a separação genérica a presença de apotécios perfurados, os quais, dentro do então gênero *Parmelia*, eram conhecidos em somente uma espécie, *Parmelia perforata* (Wulfen) Ach.

Contudo, *Parmotrema* não foi bem aceito. De fato, no primeiro grande trabalho sobre *Parmeliaceae* brasileiras, Vainio (1890) usou o nome *Parmelia*, sequer citando o gênero *Parmotrema*. Apesar disso, uma das seções que Vainio propôs dentro de *Parmelia*, *Amphigymnia*, correspondia muito bem ao conceito de *Parmotrema* de Massalongo, e essa correspondência apareceu assim listada por Zahlbruckner (1907).

Posteriormente, Dodge (1959) elevou *Amphigymnia* à categoria de subgênero, e foi sob esta denominação que Hale (1965) efetuou uma monografia mundial do grupo.

Nesse meio tempo, somente um liquenólogo francês Choisy (1952) havia utilizado o nome *Parmotrema*, porém em um senso diferente do que estava sendo usado pela literatura.

Alguns anos mais tarde, Hale (1974) restabeleceu o gênero *Parmotrema*, combinando nele todas as espécies que havia incluído em sua monografia, além das espécies pertencentes à *Parmelia* seção *Irregulares*, de que não havia tratado. Alguns liquenólogos demoraram a aceitar esta divisão (por exemplo, Krog & Swinscow 1981), apesar de posteriormente terem mudado de idéia (Krog & Swinscow 1983, Swinscow & Krog 1988). Hoje em dia o nome *Parmotrema* é amplamente utilizado, embora com uma circunscrição um tanto obscura. Cerca de 300 espécies são conhecidas para o mundo (Nash & Elix 2002b), das quais 94 foram citadas para o Brasil (Marcelli 2008).

Canomaculina Elix & Hale e *Rimeliella* Kurok.

Elix & Hale (1987) propuseram o gênero *Canomaculina* para um grupo de espécies (o grupo *Parmelia pilosa*) que tinham em comum (1) cílios robustos, marcadamente pontiagudos e geralmente furcados, (2) superfície superior com máculas efiguradas e (3) conídios filiformes com 12–16 µm de comprimento, recombinando nele três espécies: *Canomaculina consors* (Nyl.) Elix & Hale, *C. muelleri* (Vainio) Elix & Hale e *C. pilosa* (Stizenb.) Elix & Hale. Estas espécies haviam sido tratadas por Hale (1974, 1976) dentro do gênero *Parmelina* Hale, caracterizado por apresentar espécies com lobos estreitos, adnatos, (1,0) 2,0−4,0 (−5,0) mm de largura, e pela ausência de ácido úsnico no córtex superior.

Poucos anos depois, em um estudo bastante acurado, Kurokawa (1991) propôs o gênero *Rimeliella* para acomodar sete espécies com lobos largos (5,0−15,0 mm) que estavam dentro de *Parmotrema*, e que apresentavam como características principais (1) rizinas dimórficas, (2) superfície inferior de marrom a marrom-pálido (3) superfície superior com máculas efiguradas e (4) cílios freqüentemente pouco ramificados.

Entretanto, Elix (1997) afirmou que *Canomaculina* e *Rimeliella* exibiam uma sobreposição de caracteres, diferindo apenas na largura dos lobos, e propôs a sinonimização de *Rimeliella* sob *Canomaculina*.

Atualmente são conhecidas cerca de 20 espécies de *Canomaculina* (Hale & DePriest 1999), das quais 15 são citadas para o Brasil (Marcelli 2008).

Rimelia Hale & Fletcher

O gênero *Rimelia* foi proposto por Hale & Fletcher (1990), para acomodar um grupo de espécies (seção *Irregulares* Vainio), que compartilhavam (1) um córtex superior com máculas reticuladas, (2) rizinas relativamente longas (até 2 mm) normalmente atingindo a margem inferior dos lobos, não ou pouco ramificadas até esquarrosas, (3) apotécios perfurados e (4) conídios de bacilares a filiformes com 9−16 µm de comprimento. Destes caracteres, o mais importante era sem dúvida a presença de máculas reticulares, já que existem espécies de *Parmotrema* com uma ou outra dessas características.

Aproximadamente 20 espécies de *Rimelia* são conhecidas (Spielmann & Marcelli 2006).

Histórico das Espécies de *Parmotrema* s.l. com ácido salazínico

Acharius, o "Pai da Liquenologia" (Hale 1983), foi o primeiro (Acharius 1803) a propor uma espécie parmotremóide com ácido salazínico: *Parmelia perlata* (Huds.) Ach. var. *olivaria* Ach. Esta espécie já foi considerada como válida (Hale & Fletcher 1990), embora atualmente exista uma proposta de rejeitar este nome em favor de *Parmotrema pseudoreticulatum* (Tavares) Hale (Hawksworth *et al.* 2003). A outra espécie proposta por Acharius (1814) é *Parmelia cetrata* Ach. [*Parmotrema cetratum* (Ach.) Hale], com distribuição mundial e amplamente citada na literatura. Sua variação morfológica é considerada grande, e por este motivo detém uma extensa lista de sinônimos (Hale & Fletcher 1990).

Nesse meio tempo Lamarck & De Candolle (1805) descreveram *Lichen perlatus* α *ciliatus*, considerado atualmente um sinônimo de *Parmotrema reticulatum* (Taylor) M. Choisy.

Elias Fries também desenvolveu trabalhos com liquens. Em seu Systema Orbis Vegetabilis (Fries 1825) descreveu *Parmelia polita* Fr., hoje considerada sinônimo de *Parmotrema cetratum*.

Um ano depois, Persoon (*in* Gaudichaud-Beaupré 1826) descreveu três espécies, *Parmelia acanthifolia* Pers., *P. badia* Pers. e *P. maura* Pers., as quais são consideradas sinônimos de *Parmotrema cetratum* (Hale & Fletcher 1990).

Duby (1830) e Wallroth (1831) descreveram, respectivamente, *Parmelia perlata* g *ciliata* (Lam. & DC.) Duby e *Parmelia perlata* var. *tentaculata* Wallr. Atualmente, ambas são sinônimos de *Rimelia reticulata* (Hale & Fletcher 1990).

Parmelia reticulata foi proposta por Taylor (*in* Mackay 1836). O caráter "reticulado" foi adequadamente atribuído às máculas, e não às rachaduras do líquen ("*the surface marked with minute, whitish, elevated, reticulated lines*"). Este aspecto, contudo, viria causar muita confusão no futuro, pois as máculas são geralmente difíceis de serem interpretadas (Brodo 1965). Em outra publicação, Taylor (1847) descreveu *P. cristifera* e *P. stuppea*, ambas consideradas válidas atualmente.

Aparentemente a primeira ilustração de um líquen parmotremóide com salazínico foi publicada por Fée (1837), ao descrever *Parmelia latissima*, espécie reconhecida até nossos dias. Em seguida, Meyen & Flotow (1843) publicaram uma bela ilustração para *Parmelia perforata* var. *replicata* (hoje sinônimo de *Parmotrema cetratum*), baseada em material proveniente do Rio de Janeiro. Outra variedade proposta neste artigo, *Parmelia perforata* var. *ulophylla*, é hoje sinônimo de *Parmotrema cristiferum*.

Em 1866, Lindsay considerou *Parmelia reticulata* de Taylor como uma variedade de *Parmelia laevigata*, contudo esta proposição não teve aceitação (Hale & Fletcher 1990).

Krempelhuber (1869, 1873, 1876a, 1876b, 1878, 1881) publicou uma série de espécies e variedades. De suas proposições, *Parmelia glaberrima* var. *flavescens*, *Parmelia subcaperata* e *Parmelia uruguensis* são aceitas atualmente. *Parmelia angustata*, *P. perforata* var. *corniculata* e *P. perforata* f. *integra* são sinônimos de *Parmotrema cetratum*. *Parmelia hildebrandtii* é sinônimo de *Parmotrema cristiferum*, e *Parmelia concors* é sinônimo de *Parmotrema reticulatum*.

Somente uma das proposições novas de Nylander (1869, 1878, 1885, 1886, 1900), *Parmelia subsumpta*, é aceita atualmente. Sua combinação de *Parmelia flavescens* passou para *Parmotrema*. *Parmelia praeperlata* é sinônimo de *Parmotrema reticulatum*, e *Parmelia imperforata* é sinônimo de *Parmotrema subcaperatum*.

Utilizando seu conhecimento dos conídios, Stirton (1877, 1877-1878), após discutir as diferenças entre liquens de vários locais do mundo, propôs três espécies, duas das quais (*Parmelia erubescens* e *P. reparata*) são aceitas atualmente. *Parmelia owaniana* é considerada sinônimo de *Parmotrema cetratum*.

Müller Argoviensis (1880, 1883, 1886, 1891a/b, 1892, 1894) também foi prolífico na proposição de novos nomes ou novas combinações. Contudo, somente *Parmelia cetrata* var. *subisidiosa* (*Parmotrema subisidiosum*) sobreviveu até os dias de hoje.

Surgiu então E. Vainio, o "Pai da Liquenologia Brasileira" (Marcelli & Ahti 1998). Suas descrições são claras e detalhadas e seu esquema de classificação infragenérico teve um grande impacto, formando a base do sistema atual (Feuerer 1998). De suas espécies e variedades novas (Vainio 1890, 1909a/b, 1918), *Parmelia delicatula* resistiu ao tempo.

Em 1896 Harmand descreveu *Parmelia perforata* var. *claudelii* e Vainio (1909a) recombinou-a como *P. claudelii*. Atualmente, é considerada sinônimo de *Parmotrema stuppeum*.

Descrições e comentários detalhados foram publicados por Hue (1899), sendo *Parmelia eurysaca*, *P. leucosemotheta* e *P. margaritata* espécies válidas até hoje.

Em suas contribuições, Zahlbruckner (1902, 1904, 1908, 1909, 1926, 1928, 1930b) continuou a tradição iniciada por Vainio de fornecer descrições completas e acuradas sobre os liquens, além de uma listagem completa das espécies conhecidas (Zahlbruckner 1930a, 1934). Porém, somente *Parmelia subtinctoria*, *P. ramescens* e *P. ruminata* continuam sendo usadas (estas últimas espécies publicadas em Magnusson & Zahlbruckner 1944).

Jatta (1909) publicou *Parmelia urceolata* f. *ciliata*, atualmente sinônimo de *Parmotrema reticulatum.* Deve-se notar, porém, que o nome que aparece na lista de sinônimos de Hale & Fletcher (1990) para *Rimelia reticulata*, é *Parmelia perlata* var. *ciliata*.

Continuando os bons modelos de descrição apresentados por Vainio, Hue e Zahlbruckner, Lynge (1914, 1924), ao estudar as *Parmelia* coletadas por Malme na América do Sul, descreveu

Parmelia nylanderi e *P. rupta*, válidas até hoje. *Parmelia magna* e *P. radians* são consideradas sinônimos de *Parmotrema delicatulum* (Hale 1965). *Parmelia cetrata* subsp. *radiata* Lynge está na sinonímia de *Parmotrema cetratum* e *Parmelia hieronymi* é sinônimo de *Parmotrema uruguense*.

Ao descrever os liquens do México coletados pelo Irmão Arséne, Bouly de Lesdain (1914) propôs *Parmelia moreliensis*, espécie aceita até hoje.

Fink (*in* Fink & Fuson 1919) propôs *Parmelia ciliata*, uma combinação supérflua, que já havia sido publicada por Nylander (1878), e que hoje está na sinonímia de *Parmotrema reticulatum*.

Por essa época, a aplicação de nomes iguais a espécies certamente diferentes era algo comum e confuso na literatura. Du Rietz (1924a) contribuiu bastante ao esclarecer a confusão que existia em torno de *Parmelia perforata*. Sua combinação *Parmelia trichothera* var. *claudelii*, contudo (Du Rietz 1924b), não é reconhecida atualmente (sinônimo de *Parmotrema stuppeum*).

Gyelnik (1931, 1934) contribuiu para o estudo de *Parmotrema* s.l.. Das suas quatro proposições, nenhuma permanece atualmente, porém seu entendimento dos liquens e dos procedimentos nomenclaturais era bastante avançado para o seu tempo (Hale 1990).

Cengia Sambo (1930, 1939a/b/c) trabalhou com material proveniente do Brasil (*Parmelia leucoxantha* f. *firma*), Argentina e Etiópia, para o qual propôs três táxons intra-específicos, nenhum dos quais aceitos hoje em dia.

Em seus estudos sobre liquens de Taiwan (antiga Formosa), Asahina (1940)descreveu *Parmelia cetrata* f. *granularis*. Posteriormente (Asahina 1952), sinonimizou este táxon com *Parmelia cetrata* f. *subisidiosa*. Hoje é considerado sinônimo de *Parmotrema reticulatum*.

Parmelia clavulifera, proposta por Räsänen (1944) já foi considerada uma boa espécie (Kurokawa 1991, Kurokawa & Lai 2001, Moon *et al.* 2001) ou sinônimo de *Parmotrema reticulatum* (Hale & Fletcher 1990, Divakar *et al.* 2005). As outras duas proposições de Räsänen (1947), *Parmelia perforata* var. *microspora* e *P. cinerascens* var. *saxicola*, são hoje sinônimos de *Parmotrema cetratum* (Hale & Fletcher 1990).

Magnusson (*in* Magnusson & Zahlbruckner 1944) publicou somente um táxon no grupo, *Parmelia hawaiiense*, que é aceito atualmente.

Outro táxon discutido, recentemente estudado sob o prisma da biologia molecular (Divakar *et al.* 2005) é *Parmelia pseudoreticulata*, descrita por Tavares (1945).

Dodge (1959) publicou várias espécies novas ou elevou para o nível de espécie variedades ou formas propostas por Hue e por Müller Argoviensis. Destas suas combinações, somente *Parmelia subisidiosa* (hoje *Parmotrema*) é aceita.

Hale (1960, 1965, 1971, 1977, 1990) inicia, então, uma série de estudos dos liquens parmotremóides, especialmente das espécies tropicais, com uma extensa revisão de nomes antigos e proposição de várias espécies novas, todas aceitas atualmente à exceção de *Parmelia microdactyla*. O trabalho de Hale é de fundamental importância para qualquer estudo neste grupo, visto que ele teve acesso aos tipos e a uma grande quantidade de material adicional, proveniente do mundo inteiro.

Já por estes anos o estudo químico dos liquens contava com uma nova ferramenta: a cromatografia em camada delgada. Fazendo uso desta técnica, e com propostas sobre especiação em liquens, Culberson (1973) e Culberson & Culberson (1981) propuseram *Parmelia parahypotropa* e *Parmotrema paramoreliense*, ambas boas espécies.

Outro importante estudioso do grupo foi Kurokawa, que fornece dados acurados sobre os liquens que descreveu (Kurokawa 1974, 2001; Moon *et al.* 2001), o que se reflete na aceitação de todas suas espécies.

A combinação de características morfológicas e químicas sempre foi decisiva na aceitação de espécies de *Parmotrema*. Quando a substância liquexantona foi detectada pela primeira vez em liquens parmotremóides, ela justificou a descrição de *Parmelia ultralucens* (Krog 1974), uma espécie com isídios. Posteriormente, esta substância foi descoberta em uma espécie sem isídios,

Parmotrema lichexanthonicum (Eliasaro & Adler 1997), e finalmente em uma espécie sorediada, *Parmotrema pontagrossensis* (Eliasaro & Adler 1998).

Outras vezes, um caráter morfológico aberrante também suscita a suspeita de um novo táxon, como ocorreu com *Parmotrema arteagum*, que Egan (1982) descreveu para o México. Esta espécie tem conídios muito mais longos (16–23 µm) que o usual em *Parmotrema*.

Até o final dos anos 1970, nenhuma espécie havia sido descrita por um liquenólogo latino-americano. Iniciaram então os trabalhos de liquenólogos argentinos: Ferraro (1979) propôs *Parmotrema masonii*, Ferraro & Elix (1993, 2000) adicionaram duas novas espécies a esse país: *Rimelia cristobaliae* e *Canomaculina laciniella*.

Adler (1988) realizou a primeira tese de doutorado com *Parmeliaceae* na América do Sul, publicando *Canomaculina tandilense* e *C. ventanica* dentro do grupo (Adler & Elix 1987).

Elix publicou diversos estudos de espécies geralmente australianas ou sul-americanas (Adler & Elix 1987; Elix & Johnston 1988; Ferraro & Elix 1993, 2000; Elix *et al.* 2002, 2005; Benatti *et al.* 2008), nos quais um dos pontos fortes é a informação química dada a cada espécie.

Estudando liquens das Guianas e arredores, Sipman & van Aubel (1992) descreveram *Parmotrema verrucisetosum*, uma espécie única por apresentar verrugas ciliadas na superfície do talo. Sipman (2005) teve também um papel importante ao disponibilizar publicamente uma nova versão de uma chave para identificação que Hale havia feito para o neotrópico antes de seu falecimento.

Na década de 1990, os brasileiros começaram a desenvolver estudos aprofundados em liquens parmotremóides. Fleig (1997) efetuou uma revisão de *Parmotrema*, *Rimelia* e *Rimeliella* do Rio Grande do Sul, tendo analisado uma grande quantidade de material e visto praticamente todos os tipos disponíveis.

Ribeiro (1998) defendeu dissertação de mestrado sobre *Parmeliaceae* de regiões montanhosas de São Paulo, Rio de Janeiro e Minas Gerais. Dentro do grupo em estudo, foram descritas *Parmotrema lobuliferum* e *P. neosubcrinitum* (Marcelli & Ribeiro 2002).

Como resultado de sua tese de doutorado, Eliasaro (2001) publicou duas espécies novas contendo liquexantona (ver acima).

Nos anos recentes, quatro dissertações de mestrado (Canêz 2005, Spielmann 2005, Benatti 2005 e Jungbluth 2006) sobre *Parmeliaceae*, apresentaram 17 novas espécies de liquens parmotremóides com salazínico, das quais *Parmotrema anchietanum* Marcelli, Benatti & Elix, *P. asperum* Benatti, Marcelli & Elix, *P. fleigiae* Canêz & Marcelli, *P. hypermaculatum* Marcelli & Benatti, *P. lacteum* Marcelli & Spielmann e *P. pectinatum* Jungbluth & Marcelli já foram publicadas (Marcelli *et al.* 2007, Benatii *et al.* 2008). As 11 espécies restantes estão em fase de publicação.

Assim, atualmente são conhecidas, dentro dos liquens parmotremóides com salazínico:

- 63 espécies aceitas pela literatura corrente e validamente publicadas;
- 11 espécies em fase de publicação;
- 120 nomes, representados pelos tipos das espécies aceitas e seus sinônimos;
- 39 espécies citadas para a América do Sul;
- 31 citadas para o Brasil;

Diversidade das espécies de *Parmotrema* s.l. com ácido salazínico

Excetuando as espécies recentemente descobertas por Canêz (2005), Spielmann (2005) e Benatti (2005), que estão em fase de publicação, e comparando a distribuição das demais espécies, percebe-se que a América do Sul é provavelmente o centro de diversidade deste grupo, com 39 espécies registradas (Tabela 2). Para o Brasil há 31 registros, mais do que o dobro em relação ao segundo país, Venezuela, com 16 espécies citadas.

Dentro do Brasil, 13 espécies pertencentes a este grupo são citadas para o Paraná (Eliasaro 2006) 15 para São Paulo (Spielmann, dados não publicados) e 17 para o Rio Grande do Sul (Spielmann 2006).

Fora da América do Sul ocorrem outras 16 espécies de *Parmotrema*, assim distribuídas:

América do Norte: *P. arteagum*, *P. coralliforme*, *P. moreliense* e *P. permaculatum* (Egan 1982, Hale 1977, Culberson & Culberson 1981, Kurokawa 2001, respectivamente).
Ásia, América do Norte, América Central, Europa e África: *P. stuppeum* (Hale 1965).
Ásia: *P. parahypotropum* e *P. ramusculum* (Culberson 1973, Hale 1965).
Ásia e Oceania: *P. pustulatum* (Elix *et al.* 2002), veja porém *P. elixii*, adiante neste trabalho.
Ásia, Austrália e Havaí: *P. hawaiiense* (Hale & Fletcher 1990, Moon *et al*. 2001).
Havaí: *P. albinatum*, *P. ramescens* e *P. ruminatum* (Moon *et al*. 2001).
Oceania: *P. austrocetratum* e *P. erubescens* (Elix 1997, Hale & Fletcher 1990).
Europa: *P. pseudoreticulatum* (Divakar *et al*. 2005, Hale & Fletcher 1990).

Ácido salazínico

O primeiro registro deste ácido foi feito por Zopf em 1897, ao nomear o ácido que encontrou em *Stereocaulon salazinum* Bory. Contudo, a substância que Zopf encontrou nesta espécie na verdade tratava-se de ácido norstíctico (Asahina & Shibata 1954).

Asahina, em 1912, conseguiu isolar uma grande quantidade de ácido salazínico em *Parmelia cetrata* Ach. (Asahina & Shibata 1954). O reconhecimento desta espécie como portadora de ácido salazínico foi muito importante, já que ela teria uma ampla distribuição mundial (Hale & Fletcher 1990) e é, juntamente com *Parmotrema reticulatum*, freqüentemente citada como fonte de ácido salazínico para substância padrão na comparação cromatográfica em vários manuais sobre liquens (p. ex. White & James 1985, Orange *et al*. 2001).

O ácido salazínico pertence ao grupo das depsidonas e pode ser reconhecido nos testes de coloração (“spot tests”), pela reação K+ amarelo → vermelho-sangue, C– e P+ amarelo forte (Hale 1979, Orange *et al*. 2001). Já na Cromatografia em Camada Delgada (CCD), o ácido salazínico exibe um Rf relativo de 4 no solvente C e 10 no solvente A, formando pontos alaranjados na placa (Orange *et al*. 2001). Finalmente, na microcristalização, usando o reagente G.A.o-T., o ácido salazínico se microcristaliza na forma de pequenos “barcos” amarelados (Taylor 1967, Hale 1979).

Tabela 1. Cronologia das espécies de liquens parmotremóides com salazínico.

Ano	Nome original	Nome atualmente aceito (*P. = Parmotrema*)
1803	*Parmelia perlata* var. *olivaria* Ach.	*P. pseudoreticulatum*
1805	*Lichen perlatus* α *ciliatus* Lam. & DC	*P. reticulatum*
1814	*Parmelia cetrata* Ach.	*P. cetratum*
1825	*Parmelia polita* Fr.	*P. cetratum*
1826	*Parmelia acanthifolia* Pers.	*P. cetratum*
	Parmelia badia Pers.	
	Parmelia maura Pers.	
1830	*Parmelia perlata* g *ciliata* (Lam. & DC) Duby	*P. reticulatum*
1831	*Parmelia perlata* var. *tentaculata* Wallr.	*P. reticulatum*
1836	*Parmelia reticulata* Taylor	*P. reticulatum*
1837	*Parmelia latissima* Fée	*P. latissimum*
1843	*Parmelia perforata* var. *ulophylla* Mey. & Flot.	*P. cristiferum*
	Parmelia perforata var. *replicata* Meyen & Flotow	*P. cetratum*
1847	*Parmelia cristifera* Taylor	*P. cristiferum*
	Parmelia stuppea Taylor	*P. stuppeum*
1866	*Parmelia laevigata* var. *reticulata* (Taylor) Lindsay	*P. reticulatum*
1869	*Parmelia glaberrima* var. *flavescens* Kremp.	*P. flavescens*
	Parmelia subsumpta Nyl.	*P. subsumptum*
1873	*Parmelia angustata* Kremp.	*P. cetratum*
	Parmelia perforata var. *corniculata* Kremp.	
1874	*Parmelia subcaperata* Kremp.	*P. subcaperatum*
1876	*Parmelia glaberrima* f. *flavescens* (Kremp.) Kremp.	*P. flavescens*
	Parmelia perforata f. *integra* Kremp.	*P. cetratum*
1877	*Parmelia hildebrandtii* Kremp.	*P. cristiferum*
	Parmelia owaniana Stirton	*P. cetratum*
1877 - 1878	*Parmelia erubescens* Stirton	*P. erubescens*
	Parmelia reparata Stirton	*P. reparatum*
1878	*Parmelia uruguensis* Kremp.	*P. uruguense*
	Parmelia ciliata (Lam. & DC.) Nyl.	*P. reticulatum*
1880	*Parmelia latissima* f. *flavescens* (Kremp.) Müll. Arg.	*P. flavescens*
	Parmelia urceolata Eschw. var. *nuda* Müll. Arg.	*P. subsumptum*
1881	*Parmelia concors* Kremp.	*P. reticulatum*
1883	*Parmelia urceolata* var. *subcetrata* Müll. Arg.	*P. reticulatum*
1885	*Parmelia flavescens* (Kremp.) Nyl.	*P. flavescens*
1886	*Parmelia praeperlata* Nyl.	*P. reticulatum*
	Parmelia virens Müll. Arg.	*P. reparatum*
1890	*Parmelia delicatula* Vainio	*P. delicatulum*
	Parmelia cetrata f. *sorediifera* Vainio	*P. reticulatum*
	Parmelia warmingii Vainio	*P. cetratum*
1891	*Parmelia hildebrandtii* Kremp. f. *sorediosa* Müll. Arg.	*P. cristiferum*
	Parmelia mesotropa Müll. Arg. f. *sorediosa* Müll. Arg.	
	Parmelia cetrata var. *corniculata* (Kremp.) Müll. Arg.	*P. cetratum*
1892	*Parmelia virens* Müll. Arg. f. *isidiosa* Müll. Arg.	*P. subtinctorium*
1894	*Parmelia cetrata* var. *subisidiosa* Müll. Arg.	*P. subisidiosum*
1896	*Parmelia perforata* var. *claudelii* Harm.	*P. stuppeum*
1899	*Parmelia acanthifolia* f. *ornata* Hue	*P. reticulatum*
	Parmelia eurysaca Hue	*P. eurysacum*
	Parmelia ghattensis Hue	*P. reticulatum*
	Parmelia hypotropa var. *imperialis* Hue	*P. subsumptum*

<table>
<tr><td rowspan="11"></td><td>Parmelia imperforata Nyl.</td><td>P. subcaperatum</td></tr>
<tr><td>Parmelia latissima Fée f. cristifera (Taylor) Hue</td><td>P. cristiferum</td></tr>
<tr><td>Parmelia leucosemotheta Hue</td><td>P. leucosemothetum</td></tr>
<tr><td>Parmelia leucosemotheta Hue f. isidiata Hue</td><td>P. subtinctorium</td></tr>
<tr><td>Parmelia livido-tessellata Hue</td><td>P. reticulatum</td></tr>
<tr><td>Parmelia margaritata Hue</td><td>P. margaritatum</td></tr>
<tr><td>Parmelia mauriensis Hue</td><td>P. flavescens</td></tr>
<tr><td>Parmelia maxima Hue</td><td>P. stuppeum</td></tr>
<tr><td>Parmelia mutata f. decorata Hue</td><td>P. reticulatum</td></tr>
<tr><td>Parmelia olivaria (Ach.) Hue</td><td>P. pseudoreticulatum</td></tr>
<tr><td>Parmelia reticulata f. nuda Hue</td><td>P. reticulatum</td></tr>
<tr><td>1902</td><td>Parmelia petropoliensis Zahlbr.</td><td>P. subsumptum</td></tr>
<tr><td>1904</td><td>Parmelia subcaperata f. ciliata Zahlbr.</td><td>P. delicatulum</td></tr>
<tr><td>1906</td><td>Parmelia herrei Zahlbr.</td><td>P. cetratum</td></tr>
<tr><td>1908</td><td>Parmelia dusenii Zahlbr.</td><td>P. uruguense</td></tr>
<tr><td rowspan="5">1909</td><td>Parmelia claudelii (Harm.) Vainio</td><td>P. stuppeum</td></tr>
<tr><td>Parmelia claudelii (Harm.) Vainio var. clemensiae Vainio</td><td>P. cristiferum</td></tr>
<tr><td>Parmelia urceolata f. ciliata (DC) Jatta</td><td>P. reticulatum</td></tr>
<tr><td>Parmelia protoflavescens Zahlbr.</td><td>P. flavescens</td></tr>
<tr><td>Parmelia pseudoflavescens Zahlbr.</td><td>P. flavescens</td></tr>
<tr><td rowspan="6">1914</td><td>Parmelia cetrata subsp. radiata Lynge</td><td>P. cetratum</td></tr>
<tr><td>Parmelia magna Lynge</td><td>P. delicatulum</td></tr>
<tr><td>Parmelia moreliensis B. de Lesd.</td><td>P. moreliense</td></tr>
<tr><td>Parmelia nylanderi Lynge</td><td>P. nylanderi</td></tr>
<tr><td>Parmelia radians Lynge</td><td>P. delicatulum</td></tr>
<tr><td>Parmelia rupta Lynge</td><td>P. ruptum</td></tr>
<tr><td>1918</td><td>Parmelia cetrata f. platyloba Vainio</td><td>P. reticulatum</td></tr>
<tr><td>1918</td><td>Parmelia ciliata (Lam. & DC) Fink</td><td>P. reticulatum</td></tr>
<tr><td>1924</td><td>Parmelia trichotera Hue var. claudelii (Harm.) Du Rietz</td><td>P. stuppeum</td></tr>
<tr><td>1924</td><td>Parmelia hieronymi Lynge</td><td>P. uruguense</td></tr>
<tr><td>1926</td><td>Parmelia reterimulosa J. Steiner & Zahlbr.</td><td>P. reticulatum</td></tr>
<tr><td>1928</td><td>Parmelia velutina Zahlbr.</td><td>P. subtinctorium</td></tr>
<tr><td rowspan="3">1930</td><td>Parmelia corrugis (Fr.) Müll. Arg. var. imperialis (Hue) Zahlbr.</td><td>P. subsumptum</td></tr>
<tr><td>Parmelia perforata var. ciliata Sambo</td><td>P. uruguense</td></tr>
<tr><td>Parmelia subtinctoria Zahlbr.</td><td>P. subtinctorium</td></tr>
<tr><td rowspan="2">1931</td><td>Parmelia protovirens Gyelnik</td><td>P. subtinctorium</td></tr>
<tr><td>Parmelia submesotropa Gyelnik</td><td>P. cristiferum</td></tr>
<tr><td rowspan="3">1934</td><td>Parmelia amphygymnioides Gyelnik</td><td>P. reticulatum</td></tr>
<tr><td>Parmelia cristifera Taylor f. cinerata Zahlbr.</td><td>P. cristiferum</td></tr>
<tr><td>Parmelia diffusoides Gyelnik</td><td>P. reticulatum</td></tr>
<tr><td rowspan="2">1939</td><td>Parmelia leucoxantha Müll. Arg. f. firma Sambo</td><td>P. subsumptum</td></tr>
<tr><td>Parmelia odontata var. rubiginosa Sambo</td><td>P. reticulatum</td></tr>
<tr><td>1940</td><td>Parmelia cetrata f. granularis Asahina</td><td>P. reticulatum</td></tr>
<tr><td rowspan="5">1944</td><td>Parmelia cetrata var. ulcerata Zahlbr.</td><td>P. reticulatum</td></tr>
<tr><td>Parmelia clavulifera Räsänen</td><td>P. clavuliferum</td></tr>
<tr><td>Parmelia hawaiiensis H. Magn.</td><td>P. hawaiiense</td></tr>
<tr><td>Parmelia ramescens Zahlbr.</td><td>P. ramescens</td></tr>
<tr><td>Parmelia ruminata Zahlbr.</td><td>P. ruminatum</td></tr>
<tr><td>1945</td><td>Parmelia pseudoreticulata Tavares</td><td>P. pseudoreticulatum</td></tr>
<tr><td rowspan="2">1947</td><td>Parmelia cinerascens var. saxicola Räsänen</td><td rowspan="2">P. cetratum</td></tr>
<tr><td>Parmelia perforata var. microspora Räsänen</td></tr>
<tr><td rowspan="3">1959</td><td>Parmelia decorata (Hue) C.W. Dodge</td><td>P. reticulatum</td></tr>
<tr><td>Parmelia foliolosa C.W. Dodge</td><td>P. reticulatum</td></tr>
<tr><td>Parmelia gossweileri C.W. Dodge</td><td>P. cristiferum</td></tr>
</table>

	Parmelia imerinensis C.W. Dodge	*P. cristiferum*
	Parmelia menziesii C.W. Dodge	*P. cetratum*
	Parmelia ornata (Hue) C.W. Dodge	*P. reticulatum*
	Parmelia sanctae-helenae C.W. Dodge	*P. reticulatum*
	Parmelia sieberi C.W. Dodge	*P. cristiferum*
	Parmelia subisidiosa (Müll. Arg.) C.W. Dodge	*P. subisidiosum*
1960	*Parmelia microdactyla* Hale	*P. delicatulum*
1965	*Parmelia coralliformis* Hale	*P. coralliforme*
	Parmelia miranda Hale	*P. mirandum*
	Parmelia ramuscula Hale	*P. ramusculum*
1971	*Parmelia permaculata* Hale	*P. permaculatum*
1973	*Parmelia parahypotropa* W.L. Culb.	*P. parahypotropum*
1974	*Parmelia spinibarbis* Kurok.	*P. spinibarbe*
	Parmelia ultralucens Krog	*P. ultralucens*
1977	*Parmotrema concurrens* Hale	
	Parmotrema conferendum Hale	
	Parmotrema enteroxanthum Hale	
	Parmotrema expansum Hale	
	Parmotrema neotropicum Kurok.	
	Parmotrema reitzii Hale	
1979	*Parmotrema masonii* Ferraro	
1981	*Parmotrema paramoreliense* W.L. Culb. & C.F. Culb.	
1982	*Parmotrema arteagum* Egan	
1987	*Canomaculina tandilensis* Adler & Elix	*P. tandilense*
	Canomaculina ventanica Adler & Elix	*P. ventanicum*
1988	*Parmotrema austrocetratum* Elix & Johnston	
1990	*Parmotrema mantiqueirense* Hale	
1992	*Parmotrema verrucisetosum* Sipman	
1993	*Rimeliella cristobaliae* Ferraro & Elix	*P. cristobaliae*
1997	*Parmotrema lichexanthonicum* Eliasaro & Adler	
1998	*Rimelia pontagrossensis* Eliasaro & Adler	*P. pontagrossense*
2000	*Canomaculina laciniella* Ferraro & Elix	*P. laciniellum*
2001	*Parmotrema acutatum* Kurok.	
	Parmotrema despectum Kurok.	
	Rimelia albinata K.H. Moon, Kurok. & Kashiw.	*P. albinatum*
2002	*Canomaculina lobulifera* Marcelli & Ribeiro	*P. lobuliferum*
	Parmotrema neosubcrinitum Ribeiro & Marcelli	
	Rimelia pustulata Elix & Bawingan	*P. pustulatum*
2005	*Parmotrema afrocetratum* Elix, Eb. Fischer & Killmann	
2007	*Parmotrema fleigiae* Canêz & Marcelli	
	Parmotrema lacteum Marcelli & Spielmann	
	Parmotrema pectinatum Jungbluth & Marcelli	
2008	*Parmotrema anchietanum* Benatti, Marcelli & Elix	
	Parmotrema asperum Benatti, Marcelli & Elix	
	Parmotrema hypermaculatum Benatti, Marcelli & Elix	

Tabela 2. Espécies de *Parmotrema* s.l. com ácido salazínico citadas para América do Sul, excetuando espécies brasileiras propostas por Canêz (2005), Spielmann (2005) e Benatti (2005).

Espécies	AR	BO	BR	CH	CO	EQ	GU	GF	PA	PE	SU	UR	VE
P. cetratum	+	+	+	+					+	+		+	+
P. clavuliferum			+										
P. concurrens			+										
P. conferendum	+		+									+	+
P. cristiferum			+		+		+			+	+		+
P. cristobaliae	+	+	+										
P. delicatulum	+		+									+	+
P. enteroxanthum													+
P. eurysacum			+						+			+	
P. expansum			+										
P. flavescens			+		+								+
P. laciniellum	+												
P. latissimum			+		+					+			
P. leucosemothetum	+		+										
P. lichexanthonicum			+										
P. lobuliferum	+												
P. mantiqueirense			+										
P. margaritatum			+										+
P. masonii	+		+						+				
P. mirandum			+										+
P. neosubcrinitum			+										
P. neotropicum			+										+
P. nylanderi			+										
P. paramoreliense				+									
P. pontagrossense			+										
P. reitzii			+										+
P. reparatum			+										
P. reticulatum	+		+			+						+	+
P. ruptum			+						+			+	
P. spinibarbe			+										
P. subcaperatum	+		+						+			+	+
P. subisidiosum			+										+
P. subsumptum	+		+									+	
P. subtinctorium									+				
P. tandilense	+											+	
P. ultralucens			+		+	+							+
P. uruguense	+		+									+	
P. ventanicum	+												
P. verrucisetosum							+						+
TOTAL	14	02	31	02	04	02	02	0	06	03	01	10	16

Abreviações - AR: Argentina, BO: Bolívia, BR: Brasil, CH: Chile, CO: Colômbia, EQ: Equador, GU: Guiana, GF: Guiana Francesa, PA: Paraguai, PE Peru, SU: Suriname, VE: Venezuela, UR: Uruguai.

Material and Methods

Specimens were described using standard stereoscopic and light microscopic examination. Anatomical sections of apothecia and pycnidia were made with razor blades from hand. Measurements were recorded from water mounts. Permanent slides were made for all types examined, using resin PVLG (8,33 g of polyvinyl alcohol, 50 ml of lactic acid, 50 ml of distilled water and 5 ml of glycerin), following Morton *et al.* (1993), adding cotton blue instead of Melzer's reagent, and adaptation introduced by Dr. Rosely A.P. Grandi (pers. comm.) to study anamorphic fungi in the Instituto de Botânica, SP, Brazil.

Spot tests were performed with potassium hydroxide (K), sodium hypochlorite (C), and para-phenylenediamine (P) for all specimens, except the oligotypes or when chemical examination was not allowed by the herbarium curator. All taxa were also examined under UV light. Lichen substances were mainly identified by J.A. Elix (Canberra, Australia), from fragments of the types sent to him, through TLC in solvent C and HPLC, following standard methods (Huneck & Yoshimura 1996, Bungartz 2001, Orange *et al.* 2001). Otherwise some published data based on the types studied were also included, if considered reliable.

All specimens studied were also scanned at high resolution (1200 dpi), the resulting images being part of a data bank. Minute important features were also photographed coupling a digital camera to a stereomicroscope using a tripod.

The protocol used to describe the species (see below) was an adaptation of that used by the GEL (Grupo de Estudos Liquenológicos) of Instituto de Botânica (see Canêz & Marcelli 2006, Marcelli *et al.* 2007). Two terms used to describe the maculation of the upper surface are here being employed for the first time:

Hypermaculate: when the whitish macular regions are very abundant and cover most of the surface; the algae free parts are by far more extensive than the green ones, rendering the thallus a milky-grey color.

Pseudo-reticular maculae: this pattern is formed by the confluence of punctiform or effigurate maculae, giving as result a "reticular pattern" in the upper surface. However, reticular maculae usually give rise to reticular cracks, while in pseudo-reticulate species the cracks have usually an independent origin from the maculae.

A third term, *arbusculum* (pl. *arbuscula*), was used to the structures named as "coralloid isidia" by Hale (1965), since they are different from anything that could be called "isidia" in another species.

The curators of the following herbaria kindly loaned specimens (acronyms follow Index Herbariorum): ASU, B, BAFC, BM, C, CANB, CHR, COLO, CTES, DUKE, F, FI, G, H, K, L, LD, M, MIN, MSC, O, P, RO, S, SP, TNS, TUR, UPS, UPCB, US, W, and WU. The herbarium FH do not sent specimens, but made available an opportunity to stay two weeks studying specimens at Farlow. A two-week stay was performed in F, and four days in ICN.

Protocol to description of *Parmotrema* s.l. with salazinic acid

***Species* Author**
Publication not abbreviated, vol. pp. year.

Basionym Author, Publication.

Type: Localization more complete as possible, leg. *Xxxx* (type of type: herbarium!; type of type: herbarium!).
! = seen (one sign for each species)

≡ *nomenclatural (homotypic) synonym*
= *taxonomic* (*heterotypic*) *synonym*

Type description

Thallus color, laciniate/ lobate, adnate/ loosely adnate, substrate, xx cm broad. *Laciniae*/ *Lobes* dichotomous/ irregularly branched, contiguous/ laterally overlapped/ crowded, xx mm wide, *surface* continuous/ reticulate/ cracked, smooth/ scrobiculate/ rugose, lustrous/ sublustrous/ opaque, becoming rugose and cracked in/towards the center; apical zone truncate/ subtruncate/ rounded; margin smooth/ crenate/ crenulated/ incised/ irregular/ erose/ sublacinulate, plane/ undulated. *Maculae* absent or weak/ distinct/ strong/ extensive (hypermaculate), punctiform/ effigurate/ reticular/ pseudo-reticular/ irregular, laminal, marginal, just in the amphithecium, originating cracks/ pseudocyphellae/ soredia/ pustules. *Cilia* black/ absent/ color, simple/ squarrose/ furcated/ irregularly branched /dichotomous /cespitose, xx–xx mm, contiguous/ abundant/ frequent/ few/ rare, present only in the axils. *Lobules*/ *Phyllidia*/ *Dactyls*. *Lacinules* absent or simple/ branched, present in the center/ in the whole thallus, plane/ canaliculated, apex rounded/ truncate/ acute, xx–xx × xx–xx mm. *Pustules* absent or rugose/ capitate, distribution, originating soredia/ remaining entire. *Soralia* absent or color, type, linear continuous/ linear interrupted/ capitate/ extensive/ labriform/ orbicular, laminal/ marginal/ submarginal/ on the lacinules apices; *soredia* farinose/ granular/ isidioid. *Isidia* absent or base color, apex color, simple/ branched/ coralloid, xx–xx × xx–xx mm, erect/ straight/ procumbent, firm/ friable, apex ciliate/ sorediate, laminal/ marginal/ on the lacinules apices, originating... . *Medulla* white/ yellow/ ochre/ brown, color proportion. *Undersurface* color, lustrous/ opaque/ shiny, smooth/ rugose/ papillate/ veined, with/ without cracks; *marginal zone* absent or color, opaque/ lustrous/ shiny, xx mm wide, naked/ rhizinate, with sharp/ attenuated limit, smooth/ rugose/ papillate/ veined; *rhizines* black/ color/ concolor to the undersurface, simple/ furcated/ irregularly branched/ dichotomous/ squarrose, xx × xx mm, few/ frequent/ abundant/ tomentose, evenly distributed/ irregularly distributed/ distributed in groups.

Apothecia absent or plane/ concave/ cupuliform/ convex/ urceolate, xx mm in diameter, sessile/ stipitate, laminal/ submarginal/ on the laciniae apices, margin smooth/ crenate/ dentate/ coronate/ ciliate/ pustulate/ isidiate/ lobulate/ sorediate, amphithecium maculate/ rugose/ isidiate/ sorediate/ smooth/ ciliate, disc color, epruinose/ pruinose, perforate/ imperforate; *ascospores* ellipsoid/ oval/ globose/ oblong, xx–xx × xx–xx µm, episporium xx µm. *Pycnidia* absent or laminal/ submarginal/ apical, conspicuous/ inconspicuous, with/ without prominent margin, abundant/ frequent/ few/ rare, ostiole black/ brown; *conidia* filiform/ sublageniform/ bifusiform/ unciform/ bacilliform, xx–xx × ca. xx µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry:

Remarks:
About the species (main features, close taxa, etc.)

Taxonomic (history of the taxon and its taxonomic problems; opinions from several authors; explanation of our decision; excluded synonyms).

The type (s) (full comments about the size, number of parts, preservation, not seed features, annotations by others, etc.)

Distribution: verify the synonyms!

Additional specimens examined:

Results and discussion

In the following account, 61 species of *Parmotrema* s.l. with salazinic acid are keyed out, described, commented and illustrated. Due to time constrains, 12 species were not covered, but they will be included in the text submitted to publication. They are: *Parmotrema acutatum* Kurok., *P. anchietanum* Marcelli, Benatti & Elix, *P. asperum* Benatti, Marcelli & Elix, *P. arteagum* Egan, *P. despectum* Kurok., *P. fleigiae* Canêz & Marcelli, *P. hypermaculatum* Marcelli & Benatti, *P. laciniellum* (Ferraro & Elix) Blanco, Crespo, Divakar, Elix & Lumbsch, *P. neosubcrinitum* Ribeiro & Marcelli, *P. tandilense* (Adler & Elix) Blanco, Crespo, Divakar, Elix & Lumbsch, *P. uruguense* (Kremp.) Hale and *P. ventanicum* (Adler & Elix) Blanco, Crespo, Divakar, Elix & Lumbsch.

Some species features, although already employed by some authors in a greater or lesser extension, were fully considered here, as the conidial type and size, the development and morphology of soredia and isidia, the type and intensity of the maculation, the cilia length, width and ramification, the presence/absence of certain chemical substances, the underside surface and the type if ramification of rhizines.

The application of these characters, fully described in the types studied, resulted in the proposition of two new species, 14 new combinations in *Parmotrema*, and one new combination in *Parmelinella*. Due to several factors, 12 taxa remain in the *Nomina inquirenda*.

It was realized that the present species concept in the *Parmotrema* with salazinic acid is unsatisfactory, since several well-defined species were "hidden" under long lists of synonyms, usually accepted uncritically all over the world. Even trying to use a narrow species concept, some special problems remain unsolved, like the present concept of *Parmotrema cetratum* and *P. reticulatum*. Since this study is primarily based on the types available, additional specimens can help to understand better the specific limits in these species, providing new data relating to the distributional patterns, together with chemical and morphological features.

Key to the species of *Parmotrema* s.l. with salazinic acid

1 Upper cortex yellow or yellowish in herbarium; usnic acid evidently present 2
1 Upper cortex gray or brownish in herbarium; usnic acid, when present, revealed only through chemical analysis ...…... 10

2 (1) Thallus with isidia, soredia or pustules 3
2 Thallus without isidia, soredia or pustules 7

3 (2) Thallus with isidia 4
3 Thallus with soredia or pustules 5

4 (3) Maculae inconspicuous, rhizines monomorphic .... *P. flavescens*
4. Maculae effigurate, rhizines dimorphic .... *P. neotropicum*

5 (3) Thallus corticicolous, sorediate but not forming pustules, medulla C–, with hypoconstictic acid, without gyrophoric acid .... *P. mirandum*
5 Thallus saxicolous, with soredia-producing pustules, medulla C+ rose, with gyrophoric acid, without hypoconstictic acid 6

6 (5) Thallus lobate, lobes 1.0–4.5 mm wide, cilia frequent or totally absent in some lobes .... *P. nylanderi*
6 Thallus laciniate, laciniae 0.8–3.0 mm wide, abundantly ciliate .... *P. pectinatum*

7 (2) Upper surface with effigurate maculae, rhizines dimorphic .... *P. subcaperatum*
7 Upper surface without maculae, rhizines monomorphic 8

8 (7) Thallus corticicolous, cilia up to 0.7 mm long, medulla C–, without gyrophoric acid .... *P. masonii*
8 Thallus saxicolous, cilia up to 2.8 mm long, medulla C+ rose or C–, gyrophoric acid present in variable concentration 9

9 (8) Thallus lobate, lobes wide (5–15 mm), apothecial disc usually lacerate, amphithecium rugose to scrobiculate .... *P. magnum*
9 Thallus sublaciniate, sublaciniae narrow (1.0–3.5 mm), apothecial disc entire, amphithecium smooth .... *P. delicatulum*

10 (1) Medulla yellow .... *P. enteroxanthum*
10 Medulla white, sometimes faint rose (decomposition of the salazinic acid) 11

11 (10) Medulla UV+ yellow (lichexanthone), cespitose cilia abundant 12
11 Medulla UV– (without lichexanthone); cespitose cilia uncommon 15

12 (11) Thallus without vegetative propagules, usually with apothecia .... *P. lichexanthonicum*
12 Thallus with isidia or soredia, with or without apothecia 13

13 (12) Thallus isidiate .... *P. ultralucens*
13 Thallus sorediate 14

14 (13) Soredia produced in botryose structures .... *P. spinibarbe*
14 Soredia not produced in botryose structures .... *P. pontagrossense*

15 (11) Thallus with lacinules forming arbuscular structures 16
15 Thallus without arbuscular structures 17

16 (15) Arbuscula ciliate and esorediate, upper surface with effigurate maculae, cilia abundant .... *P. coralliforme*
16 Arbuscula eciliate and sorediate, upper surface with punctiform maculae, cilia sparse .... *P. ramusculum*

17 (15) Upper surface with ciliate warts .... *P. verrucisetosum*
17 Upper surface without ciliate warts 18

18 (17) Upper surface without maculae 19
18 Upper surface with effigurate, reticulate or extensive (hypermaculate) maculae 25

19 (18) Thallus without vegetative propagules 20
19 Thallus with isidia or soredia 21

20 (19) Lobes eciliate, conidia sublageniform .... *P. latissimum*
20 Lobes ciliate, conidia filiform .... *P. mantiqueirense*

21 (19) Thallus isidiate .... *P. concurrens*
21 Thallus sorediate 22

22 (21) Ascospores large, 25–35 µm long, ... 23
22 Ascospores medium-sized, 12–17 µm long 24

23 (22) Lobes eciliate or with rare simple cilia .... *P. cristiferum*
23 Lobes conspicuously ciliate, cilia simple to furcated .... *P. sieberi*

24 (22) Thallus with lacinules, conidia short-filiform .... *P. maximum*
24 Thallus without lacinules, conidia sublageniform .... *P. stuppeum*

25 (18) Upper surface with maculae primarily effigurate (a few extensive may occur) 26
25 Upper surface with reticular or extensive maculae, never effigurate 43

26 (25) Thallus without vegetative propagules 27
26 Thallus with isidia or soredia 33

27 (26) Undersurface brown or with a blackish-brown center 28
27 Undersurface jet-black 30

28 (27) Cilia usually furcated, maculae strong, rhizines monomorphic .... *P. bifidum*
28 Cilia rarely furcated, maculae weak to distinct, rhizines dimorphic 29

29 (28) Undersurface extensively light brown, usnic acid absent .... *P. erubescens*
29 Undersurface brown to blackish-brown, usnic acid present .... *P. subcaperatum*

30 (27) Thallus with lacinules, medulla with norlobaridone .... *P. cristobaliae*
30 Thallus without lacinules, medulla without norlobaridone 31

31 (30) Rhizines dimorphic .... *P. reparatum*
31 Rhizines monomorphic 32

32 (31) Cilia simple .... *P. permaculatum*
32 Cilia usually furcated .... *P. expansum*

33 (26) Thallus isidiate 34
33 Thallus sorediate 35

34 (33) Undersurface abundantly veined, usnic acid present, norlobaridone absent ....
.... *P. neotropicum*
34 Undersurface slightly rugose to papillate, usnic acid absent, norlobaridone present, ……
.... *P. subtinctorium*

35 (33) Soralia growing from the lobe margins towards the undersurface 36
35 Soralia strictly marginal, or on the upper surface, then submarginal, capitate or growing in pustuloid formations 37

36 (35) Thallus lacinulate, rhizines monomorphic, conidia unciform .... *P. parahypotropum*
36 Thallus without lacinules, rhizines dimorphic, conidia filiform .... *P. subsumptum*

37 (35) Undersurface light brown to dark brown, rarely blackish-brown in central areas 38
37 Undersurface black 40

38 (37) Cilia frequently furcated, maculae weak .... *P. petropoliense*
38 Cilia simple, maculae distinct to strong 39

39 (38) Maculae strong, rhizines monomorphic, under marginal zone erhizinate ....
.... *P. leucosemothetum*
39 Maculae distinct, rhizines dimorphic, under marginal zone rhizinate .... *P. reitzii*

40 (37) Thallus laciniate, cilia simple, up to 5 mm long .... *P. paramoreliense*
40 Thallus lobate to sublaciniate, cilia simple or furcated, up to 2 mm long …................. 41

41 (40) Cilia furcated frequent .... *P. concors*
41 Cilia exclusively simple 42

42 (41) Lacinules abundant, often with subapical soralia .... *P. margaritatum*
42 Lacinules absent, soralia laminal or marginal .... *P. pseudoreticulatum*

43 (25) Thallus without isidia, soredia, pustules or schizidia 44
43 Thallus with isidia, soredia, pustules or schizidia 51

44 (43) Thallus laciniate, laciniae narrow (up to 3 mm) 45
44 Thallus lobate or wide-laciniate (2–5 mm or even wider) 46

45 (44) Cilia simple .... *P. warmingii*
45 Cilia branched common .... *P. herrei*

46 (44) Thallus with conspicuous lacinules 47
46 Thallus without lacinules or with a few sublacinules 48

47 (46) Lacinules with acute apices, ornate with black outlined pycnidia .... *P. eurysacum*

47 Lacinules often spatulate or with the apex enlarged, pycnidia without black outline .... *P. austromaculatum*

48 (46) Cilia usually squarrose .... *P. radiatum*
48 Cilia simple or rarely furcated 49

49 (48) Under marginal zone naked, apothecia imperforate .... *P. ruptum*
49 Under marginal zone rhizinate, apothecia perforate 50

50 (49) Maculae reticular, conidia 10–14 µm .... *P. cetratum*
50 Maculae reticular to extensive (hypermaculate), conidia 6.5–9.0 µm .... *P. acanthifolium*

51 (43) Thallus with abundant flaking off areolae (schizidia) .... *P. austrocetratum*
51 Thallus with isidia, soredia or pustules, rarely with flaking off areolae 52

52 (51) Isidia present 53
52 Isidia absent 54

53 (52) Isidia simple to coralloid, not forming soredia .... *P. subisidiosum*
53 Isidia sorediod, formed by sorediose clusters .... *P. lacteum*

54 (52) Thallus with pustules, which can originate soredia or not 55
54 Thallus without pustules, with soredia 58

55 (54) Thallus with lacinules .... *P. granulare*
55 Thallus without lacinules 56

56 (55) Cilia absent or rare .... *P. ruminatum*
56 Cilia frequent to abundant 57

57 (56) Pustules ± capitate, forming dense agglomerations .... *P. elixii*
57 Pustules rugose, nor forming agglomerations .... *P. nudum*

58 (54) Soredia usually formed at the apices of lacinules, rarely submarginal 59
58 Soredia mostly submarginal, only a few formed at the apices of sublacinules 60

59 (58) Upper surface hypermaculate, medulla with lobaric acid .... *P. albinatum*
59 Upper surface with reticular maculae, medulla without lobaric acid .... *P. clavuliferum*

60 (58) Cilia simple to furcated, up to 3.5 mm long, maculae strong .... *P. livido-tesselatum*
60 Cilia simple, rarely furcated, up to 1.5 mm long, maculae distinct 61

61 (60) Under marginal zone rhizinate, conidia 8.5–12 µm .... *P. reticulatum*
61 Under marginal zone naked or papillate, conidia 11–26 µm 62

62 (61) Cilia simple, up to 1.5 mm long, conidia 11–16 µm .... *P. reterimulosum*
62 Cilia simple to rarely furcated, up to 0.5 mm long, conidia 15–26 µm .... *P. foliolosum*

Parmotrema acanthifolium **(Pers.) Spielmann & Marcelli, comb. nov.**

Parmelia acanthifolia Pers., *in* Gaudichaud-Beaupré, Voyage autour du monde, exécuté sur les corvettes l'Uranie et la Physcienne, sur les ordres du Cap. L. de Freycinet, en 1817-1820, Botanique, p. 197. 1826. – Type: Brazil, [Rio de Janeiro State, Municipality of] Rio de Janeiro, corticicolous, leg. *Gaudichaud* 13 (holotype: PC!)

(Fig. 01)

Holotype description

Thallus brownish (herbarium), lobate, corticicolous, 9 cm broad. *Lobes* irregularly branched, laterally overlapped, 2–7 mm wide, *surface* continuous, smooth, lustrous, becoming irregularly cracked towards the center; apical zone rounded; margin crenate to sinuous, slightly undulated. *Maculae* reticular to extensive (hypermaculate), sometimes inconspicuous, laminal, not originating cracks. *Cilia* black, simple or rarely with lateral branchlets, up to 1 mm long, 0.02–0.06 mm wide, abundant. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* impossible to describe in detail since the thallus is totally glued to a paper sheet, apparently black, lustrous, smooth to rugose or papillate; *marginal zone* brown, lustrous, 1–2 mm wide, rhizinate to papillate, with an attenuated limit; *rhizines* black, simple to squarrose, up to 2 mm long, 0.01–0.05 mm wide, apparently abundant.

Apothecia cupuliform, 2–10 mm in diameter, stipitate, submarginal, margin crenate to sinuous, amphithecium maculate, smooth or irregularly pitted, disc dark brown, epruinose, perforate at maturity; *ascospores* ellipsoid, 13.5–15 × 8.5–10 µm, episporium ca 1 µm. *Pycnidia* submarginal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* short-filiform, 6.5–9.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major) and consalazinic acid (minor).

Remarks: *Parmotrema acanthifolium* is distinct by the lobate thallus with reticular maculae or hypermaculate, the short conidia (6.5–9.0 µm) and the absence of lacinules.

This species is close to *P. cetratum*, and was already considered a synonym (Hale & Fletcher 1990). However, the hypermaculate thallus and shorter conidia (10–14 µm in *P. cetratum* according to Hale & Fletcher 1990) seems to be sound charaters to recognize *P. acanthifolium* as a good species.

Parmotrema ruptum, another close species, has imperforate apothecia, longer conidia (10–12.5 µm), shorter ascospores (10–12.5 × 6.0–7.5) and a distinct bare marginal zone on the undersurface.

Apparently one of the first authors to accept *Parmelia acanthifolia* as a good taxon was Vainio (1890), applying this name to specimens gathered by him in Sitio (nowadays Municipality of Antonio Carlos, Minas Gerais State). Afterwards, Müller Argoviensis (1893) reported the species to Costa Rica, Hue (1895) to California (U.S.A.), Zahlbruckner (1909) included it in his key to the Brazilian *Parmelia*, and Lynge (1924) mention it for Uruguay.

The record of Vainio (1890) was questioned by Hale (1960), who stated that it was based on *Parmelia subcaperata* Kremp. About Lynge (1924), Hale (1960) stated that the species was probably destroyed in Berlin during the Second World War.

In the protologue (Gaudichaud-Beaupré 1826) only one specimen was cited, and so it is the holotype (*Vienna Code*, article 9.1 Note 1), not a lectotype as suggested by Hale & Fletcher (1990).

Distribution: U.S.A (Hue 1895), Costa Rica (Müller Argoviensis 1893), Uruguay (Lynge 1924) and Brazil, where it was recorded to the States of Minas Gerais (Vainio 1890) and Rio de Janeiro (Gaudichaud-Beaupré 1826).

***Parmotrema albinatum* (Moon, Kurok. & Kashiw.) Blanco, Crespo, Divakar, Elix & Lumbsch**
Mycologia 97 (1): 157. 2005.

Rimelia albinata K.H. Moon, Kurok. & Kashiw., Journal of Japanese Botany 76 (6): 322. 2001. – Type: U.S.A., Hawaii, Molokai Island, Molokai District, below Puu Kolekole, 21°05′ N, 156°54′ W, on soil, elevation about 1150 m, November 4, 1997, leg. *Y. Ohmura* 4210 (holotype: TNS!; isotype: BISH).

(Figs. 02-03)

Holotype description

Thallus whitish, sublaciniate, loosely adnate, terricolous, 6.5–10 cm broad; *sublaciniae* irregularly branched, crowded, 2–5 mm wide; *surface* continuous to minutely notched, rarely cracked, smooth to irregular, lustrous, pruinose in the lobes apices; apical zone rounded; margin crenate to sublacinulate, undulated. *Lacinules* simple to furcated, localized in the whole thallus, usually plane, sometimes slightly canaliculated, apex acute when without soredia, although frequently sorediate, then capitate or growing backwards, 0.5–2.5 × 0.3–1.5 mm, underside beige. *Maculae* “absent”. *Cilia* black, simple, thin, 0.5–1.2 × 0.02–0.05 mm, ± abundant. *Soralia* concolor to the thallus, capitate, extensive or labriform, formed on the lacinules apices or in some margins, which become involute; *soredia* subgranular. *Isidia* and *pustules* absent. *Medulla* white. *Undersurface* black (beige under the lacinules and sorediate lobes), lustrous, papillate, rarely with scars; *marginal zone* dark brown, lustrous, 1.5–2.0 mm wide, rhizinate or sometimes without rhizines, with an attenuated limit, smooth to papillate; *rhizines* black, simple, branched near the apices or squarrose, 0.5–2.0 × 0.01–0.06 mm, abundant, ± evenly distributed. *Apothecia* absent. *Pycnidia* laminal to submarginal, especially abundant in the lacinules, conspicuous, frequent, ostiole black; *conidia* filiform, 7.5–10.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin, salazinic and trace of lobaric acid (Moon *et al.* 2001).

Remarks: *Parmotrema albinatum* is characterized by the sorediate and short-lacinulate thallus with medullar salazinic acid and traces of lobaric acid. The upper surface is distinctly whitish, probably caused by the very thick upper cortex.

It is close to *P. clavuliferum*, a species producing long lacinules and which instead of lobaric acid presents only fatty acids (Kurokawa 1979).

We described maculae “absent” since the upper cortex is as whiter as the maculae normally are in *Rimelia*-like species, and what one can see in *P. albinatum* is just an inconspicuous surface relief in a reticular pattern.

The specimen preserved in TNS is labeled as the holotype, and one of its parts was illustrated in the protologue, so probably the isotype is in BISH. This information is contrary to that published in the same protologue (Moon *et al.* 2001). There is no statement if the three parts in the holotype collection are from the same thallus, and only one of them was illustrated in the

protologue. They are, notwithstanding, similar in every respect and seem to be really parts of the same specimen. A label with the holotype, made by K.H. Moon in 1998, gives the following chemistry: atranorin, norlobaridone and salazinic acid. One other label (undated but with Kurokawa's handwriting), asserts that the specimen *Ohmura* 4210 has atranorin, salazinic acid and lobaric acid (++). The last information is taken, by the moment, as the correct since it was published in the protologue.

The terricolous habit of the holotype (Fig. 03) is very rare in this group of species (apparently just known in *P. herrei*). However, in the protologue one saxicolous and one corticicolous specimens are additionally listed. So maybe the substrate, in this case, is not an important feature to be considered.

Distribution: Hawaiian Islands (Moon *et al.* 2001).

Parmotrema austrocetratum **Elix & Johnston**
Mycotaxon 31 (2): 495. 1988.

Type: New Zealand, North Island, Taranaki Land District, New Plymouth, Burgess Park, 60 m, on tree trunk in remnant forest, 07.V.1980, leg. *J.A. Elix* 7979 (holotype: CHR!; isotype: CANB!).

≡ *Rimelia austrocetrata* (Elix & Johnston) Hale & Fletcher, The Bryologist 93 (1): 26. 1990.

(Figs. 04-05)

Holotype description

Thallus beige (herbarium), lobate, loosely adnate, corticicolous, 12.5 × 8.0 cm broad; *lobes* irregularly branched, laterally overlapped, 6–9 mm wide; *surface* lustrous, pruinose in some places, reticulate or cracked, the reticulations giving rise to a pattern resembling a mosaic of areolae, the areolae can develop revolute margins and finally flake off (*schizidia*), showing the medulla, in the central part of the thallus convex areolae can be seen, usually associated with a strong rugosity of the thallus; apical zone rounded; marginal zone undulate, margin crenate. *Maculae* distinct, reticular, laminal, originating areolae mosaics. *Cilia* black, simple or sometimes squarrose, 0.1–1.6 × 0.02–0.05 mm, abundant in some lobes. *Lacinules* simple or little branched, plane to canaliculated, apex usually acute, sometimes rounded or truncate, 0.5–7.0 × 0.2–1.4 mm. *Pustulae*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* not seen (thallus pasted in a paper card).

Apothecia cupuliform to urceolate, lacerate when well developed, 2.0–14.0 mm in diameter, stipitate, laminal to submarginal, margin smooth to slightly crenate, sometimes denticulate, amphithecium maculate, smooth to scrobiculate, disc pale brown, epruinose, perforate only in some very old apothecia; *ascospores* ellipsoid, 12.5–15.0 × 8.5–10.0 µm, episporium 1.0–1.5 µm. *Pycnidia* submarginal to laminal, especially abundant in some lacinules, conspicuous, usually without prominent margin, ostiole black; *conidia* filiform, 8.0–25.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin, chloroatranorin, salazinic acid, consalazinic acid and trace of protocetraric acid (Elix & Johnston 1988).

Remarks: *Parmotrema austrocetratum* is distinguished by the formation schizidia (Fig. 05) and lacinules, and the presence of salazinic acid.

Elix & Johnston (1988) described the process of wrinkles formation by means of pressured areolae of the upper cortex, which also can flake out, and called them dactyls. However, the more appropriate term is schizidia, as already suggested by Moon *et al.* (2001), who placed *P. austrocetratum* as a synonym of *P. hawaiiense*, a position we do not agree, since *P. hawaiiense* do not develops lacinules, has smooth upper surface and smaller conidia (10–15 µm).

Another close species is the eciliate and pustulate *P. ruminatum* (see comments under this species).

The holotype of *P. austrocetratum* is a well developed specimen in excellent state of preservation. Notwithstanding, is totally glued by the undersurface to a paper card, so that it's impossible to describe the underside characters. Near the specimen there's a label with the chemical composition: atranorin, chloroatranorin, salazinic acid (major) and consalazinic acid, determined by TLC, the analyst being P.M.A. This information differs a little from the published one, where traces of protocetraric acid were also noted.

The isotype (CANB) is also glued by the underside. Unfortunately, as no additional specimens of *P. austrocetratum* were seen, the undersurface features could not be studied.

In correct number of the holotype is *J.A. Elix* 7979, not *J.A. Elix* 4645, as published in the protologue (Elix & Johnston 1988). This aspect was also annotated by Streimann (label with the isotype).

It was very hard to find pycnidia with conidia. After some attempts, very short ones were found (7–12,5 µm). Yet, on a final attempt very long ones (up to 25 µm long) were found. As far as we know, this is a new record in *Parmotrema*, followed by *Parmotrema arteagum* (conidia up to 23 µm, according to Egan 1982).

Distribution: Australia and New Zealand (Elix & Johnston 1988, Galloway 2007).

***Parmotrema austromaculatum* Spielmann & Marcelli, sp. nov.**

Type: Brazil, Rio Grande do Sul State, Municipality of Boqueirão do Leão, Linha Sinimbuzinho, Perau da Nega, 29°20′17.2″S, 52°26′33.6″W, 430 m, saxicolous, left margin of the stream, close to the vertical slope, open place, 23.II.2004, leg. *A.A. Spielmann* & *L.S. Canêz* 1111 (holotype: SP).

(Fig. 06)

Holotype description

Thallus greenish gray, lobate, loosely adnate, saxicolous, 18 cm broad. *Lobes* irregularly branched, laterally overlapped to crowded, 5–30 mm wide, *surface* smooth to reticulately cracked, sometimes pruinose, opaque to sublustrous, becoming notched and reticulately cracked towards the centre; apical zone rounded, plane to strongly concave; margin crenate to broadly crenate, ascendant or revolute, undulated; lateral margin usually ascendant and revolute, regular to undulated, often lacinulate. *Maculae* distinct, reticular or hypermaculate, laminal, originating cracks or not. *Cilia* black, usually simple, rarely furcated, sinuous, often ascendant, especially at the lobe apices, 1.0–3.5 × 0.03–0.10 (–0.15) mm, abundant. *Lacinules* plane to concave, simple to furcated or irregularly branched, sometimes subpalmate, often spatulate or with the apex enlarged, rounded or concave, or apex acute to truncate, abundant, 0.5–6.0 × 0.5–7.0 mm, lower surface black, brown, or rarely white variegated. *Pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, mainly smooth to sometimes rugulose or slightly papillate, rarely veined, with cracks; *marginal zone* dark brown, occasionally black or rarely pale brown or

white variegated, lustrous, 1–7 mm wide, naked, with an attenuated limit, smooth to rugulose or papillate; *rhizines* black, usually simple, sometimes furcated or irregularly branched, 0.3–4.0 × 0.02–0.20 mm, frequent, distributed in groups.

Apothecia concave to cupuliform or ± urceolate, 2–6 mm in diameter, stipitate, submarginal, margin smooth to crenulated or incised, amphithecium maculate, smooth to rugose, disc brown, epruinose, entire to lacerated, perforate at maturity; *ascospores* broadly ellipsoid, 10.0–12.5 × 8.0–9.0 µm, episporium ca. 1.0 µm. *Pycnidia* submarginal, conspicuous, with prominent margin, frequent especially in the lacinules, ostiole black; *conidia* filiform, (7.5–) 9.0–11.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C: atranorin, salazinic acid and consalazinic acid.

Remarks: *Parmotrema austromaculatum* is characterized by the distinct reticular maculae, often hypermaculate, conspicuous lacinules, wide lobes (up to 30 mm) and long cilia (up to 3.5 mm).

Similar to *Parmotrema eurysacum* (Hue) Hale, which can be differentiated by the lacinules with submarginal pycnidia ornate with a black outline.

The species is abundant at the type locality. Additional specimens studied revealed only minor differences: thalli varied from 6 to 30 cm broad. Lacinules were 40.4–20.0 × 0.5–8.0 mm. Cilia reached up to 5 mm of length and conidia were 7.5–14.0 µm long.

Distribution: known only from the type locality.

Paratypes: Brazil, Rio Grande do Sul State, Municipality of Boqueirão do Leão, Linha Sinimbuzinho, Perau da Nega, 29°20′02.2″S, 52°26′27.9″W, 440 m alt., on rock at stream margin, open place, 24.II.2004, leg. *A.A. Spielmann* & *L.S. Canêz* 698, 705 (SP); the same, 29°20′17.2″S, 52°26′33.6″W, 430 m alt., saxicolous, left margin of the stream, near the steep slope, open place, 23.II.2004, leg. *A.A. Spielmann* & *L.S. Canêz* 1340, 1341, 1342, 1343, 1344, 1345, 1358, 1365 (SP).

Parmotrema bifidum **Spielmann & Marcelli, sp. nov.**

Type: Brazil, Mato Grosso State, Serra da Chapada [nowadays Chapada dos Guimarães], Bocca da Serra, ad rupes , 15.VI.1894, leg. *G.O.A. Malme* (holotype: S!).

(Figs. 07-10)

Holotype description

Thallus milky grayish, lobate, loosely adnate, saxicolous, 11 cm broad. *Lobes* irregularly branched, laterally overlapped, 3–7 mm wide, with a distinct black line, thickened at the sinuses, *surface* continuous, smooth, lustrous, becoming strongly cracked and sometimes rugose towards the center, the cracks usually perpendicular to the lobe axis; apical zone rounded; margin sinuous-incised, undulated. *Maculae* strong, effigurate, laminal, originating cracks. *Cilia* black, simple to usually furcated, sometimes more branched, up to 1 mm long, usually thick, 0.05–0.15 mm wide, abundant. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* pale brown, opaque to sublustrous, usually smooth, slightly rugose or papillate in some areas, without cracks; *marginal zone* dark brown, shiny, 1–3 mm wide, naked, with an attenuated limit, smooth or rarely papillate; *rhizines* dark brown, simple or less frequently

furcated or irregularly branched, up to 2 mm long, usually thickened, (0.2–) 0.5–0.20 mm wide, abundant, irregularly distributed, leaving several areas nude.

Apothecia cupuliform, 1.5–9.0 mm in diameter, substipitate, submarginal, margin usually involute, smooth to irregularly incised, amphithecium maculate, rugose-foveolate, disc pale to dark brown, epruinose, perforate or imperforate; *ascospores* ellipsoid, 11–14 × 6.5–7.5 µm, episporium 0.5–1.0 µm. *Pycnidia* submarginal or sometimes advancing over the lamina, conspicuous, without prominent margin, abundant, ostiole black; *conidia* short-filiform, 6–10 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), protocetraric acid (trace).

Remarks: *Parmotrema bifidum* is distinguished by the thickened furcated cilia, strong effigurate maculae, and the brown underside with a naked and shiny dark brown marginal zone. It must be noted that the under marginal zone is darker than the center, a rare pattern inside *Parmotrema* with salazinic acid (present also in *P. petropoliense*).

Parmotrema expansum also develops furcated cilia and effigurate maculae; however, has a distinct shiny jet-black undersurface.

The shiny under marginal zone and branched cilia can be compared with *P. lichexanthonicum*, which contain lichexanthone and has weak maculae. Strongly effigurate maculae occur in *P. leucosemothetum*, distinguished by the simple longer cilia (up to 3 mm).

The cilia of *P. bifidum* resemble those of *Parmotrema consors* (Nyl.) Krog & Swinscow, a common Brazilian species that contains only fatty acids (Spielmann & Marcelli 2009). On the other hand, in this species the cilia are usually turned down, while in *P. bifidum* they are prostrate or ascending.

Lynge (1914), when describing *Parmelia cetrata* Ach. subsp. *radiata* Lynge, listed two specimens, one from Paraguay and another from Brazil. Later on, Hale (1960) made the typification of this taxon choosing the specimen from Paraguay as lectotype. Hale & Fletcher (1990) placed *P. cetrata* subsp. *radiata* as synonymous of *Parmotrema cetratum*. This taxon actually constitutes a good species, *P. radiatum* (see comments under it). The Brazilian syntype in not conspecific with it, and it is here being described as *P. bifidum*.

Distribution: Known only from the type locality.

***Parmotrema cetratum* (Ach.) Hale**
Phytologia 28 (4): 335. 1974.

Parmelia cetrata Ach., Synopsis Methodica Lichenum: 198. 1814. – Type: U.S.A., Pennsylvania, leg. *Muhlenberg* s.n. (lectotype: H-ACH!; duplicate of the lectotype: UPS, photo!).

≡ *Rimelia cetrata* (Ach.) Hale & Fletcher, The Bryologist 93 (1): 26. 1990.

(Fig. 11)

Lectotype description

Thallus brownish (herbarium), laciniate, corticicolous (fide Acharius 1814), 3.5 cm broad. *Laciniae* irregularly branched, 2–5 mm wide, *surface* continuous, smooth, lustrous, becoming reticulately cracked towards the center; apical zone slightly rounded to acute; margin smooth, plain to slightly undulated. *Maculae* distinct, reticular, laminal, originating cracks. *Cilia* black, simple to furcated, up to 1.3 mm long, 0.02–0.05 (–0.10) mm wide, abundant. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, smooth, with cracks; *marginal zone* absent; *rhizines* black, apparently simple or squarrose, up to 1 mm long, abundant.

Apothecium plane (probably pressed), 1.7 mm in diameter, probably stipitate and laminal, margin incise to deeply incised, disc blackish brown, epruinose, perforate; *ascospores* ellipsoid, 12.5–15 × 8–10 µm, episporium 1.0–1.5 µm. *Pycnidia* laminal, conspicuous, without prominent margin, frequent, ostiole black; *conidia* not found (10 pycnidia examined).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema cetratum* is recognized by the reticular maculae, the absence of propagules, the presence of salazinic acid, and absence of lacinules.

This species is part of a complex and misunderstood group, and several good, but frequently abundantly lacinulate species has been synonymized under *P. cetratum* based on the combination of a small set of characters usually observed.

While studying the rich lichenized mycota of Southern Brazil, Fleig (1997) and Eliasaro (2001) found significant differences in the maculation of the specimens. Spielmann (2005) asserted that some morphologically distinct specimens could be good taxa. Divakar *et al*. (2005) through molecular data, also pointed out the necessity to revise *P. cetratum* and its synonyms, since specimens from Costa Rica tentatively identified as this species were morphologically and molecularly distinct from the Uruguayan ones.

The revision of the types of the synonyms showed that significant morphological differences were hidden under the name *P. cetratum*, a species that probably is much more restricted in its distribution, maybe centered in Eastern North America and perhaps extending to other temperate climates. Therefore, we are proposing some accepted synonyms (see Hale & Fletcher 1990) as good species: *Parmelia acanthifolia* Pers., *Parmelia cetrata* Ach. subsp. *radiata* Lynge, *Parmelia herrei* Zahlbr and *Parmelia warmingii* Vainio. See the key and comments under each of these taxa for more detailed information.

Other synonyms are placed as *nomina inquirenda*, since the types were not seen or, chiefly because their size or preservation condition, do not have sufficient well-preserved characters to clarify their status: *Parmelia cinerascens* var. *saxicola* Räs., *P. maura* Pers., *P. menziesii* C.W. Dodge, *P. perforata* var. *microspora* Räs, *P. perforata* var. *replicata* Meyen & Flotow and *P. polita* Fr.

The lectotype of *P. cetratum* (H) is a poor specimen 3.5 cm broad, although with a well-developed apothecium, mixed with one *Parmelia* sp. and glued in a paper. It was consequently very difficult to study the undersurface. Moreover, the interpretation of thallus morphology was difficult: we called the thallus laciniate, although it could be well only part of a larger lobed specimen, since signs of another glued specimen are visible.

Unfortunately, conidia were not found in the lectotype. Future studies including the duplicate of the lectotype (UPS) and additional specimens recently discovered in the PH Herbarium

(Lendemer & Hewitt 2002) are fundamental to verify this feature, since Hale & Fletcher (1990) did not inform the specimen from which the ascospores and conidial data were furnished.

The herbarium UPS sent a photograph of the duplicate of the lectotype of *P. cetrata*, represented by a quite larger thallus, apparently without apothecia, but with more developed laciniae. It seems to agree well with the lectotype. The same *Parmelia* sp. is also growing with the specimen so it is probably from the same locality or maybe it was before glued together with the lectotype.

The typification of *P. cetratum* was made by Hale & Fletcher (1990). We do not know, however, how these authors concluded that the type locality was Pennsylvania, since both the protologue and the lectotype (H) indicate only "America Septentrionalis".

Because the proposed changes, at the present we cannot have a real idea of the "true" distribution of *Parmotrema cetratum*. The references below are maintained, however, as a guide to the current literature on this name.

Distribution (probably unreal): Oceania (Elix 1994, Galloway 1985, Malcolm & Galloway 1997, Louwhoff & Elix 1999), Asia (Awasthi 1976, Kurokawa & Lai 2001), Africa (Krog & Swinscow 1981, Swinscow & Krog 1988, Hale & Fletcher 1990, Aptroot 1991), North America (Hale & Fletcher 1990, Brodo *et al.* 2001, Nash & Elix 2002c, Esslinger 2008), Central America (Feuerer 2008) and South America (Hale & Fletcher 1990). In South America it is known to Argentina (Lynge 1924, Osorio 1976, Hale & Fletcher 1990, Adler 1992, Calvelo & Liberatore 2002), Bolivia (Feuerer *et al.* 1998), Brazil (Marcelli 2004), Chile (Feuerer 2008), Paraguay (Lynge 1914), Peru (Feuerer 2008), Uruguay (Lynge 1924; Osorio 1972, 1992b, 1995, 2003) and Venezuela (Vareschi 1973). In Brazil it was recorded to the States of Minas Gerais (Lynge 1914, 1924; Hale & Fletcher 1990, Ribeiro 1998), Mato Grosso (Lynge 1914), Paraná (Osorio 1977a/b, Fleig 1997, Eliasaro 2001), Rio de Janeiro (Lynge 1924), Rio Grande do Sul (Spielmann 2006), Santa Catarina (Marcelli 1992, Osorio 1997, Fleig 1997) and São Paulo (Marcelli 1991, 1992; Ribeiro 1998).

***Parmotrema clavuliferum* (Räs.) Streimann**
Bibliotheca Lichenologica 22: 93. 1986.

Parmelia clavulifera Räsänen, Annales Botanici Societatis Zoologicae Botanicae Fennicae 20 (3): 4. 1944. Type: Oceania, Tahiti, ad corticem arboris, 1868, leg. Dr. med. *Bouffon* vel *E. Vieillard* (lectotype: H!; paratype: H!).

≡ *Rimelia clavulifera* (Räs.) Kurok., Journal of Japanese Botany 66 (3): 158. 1991.

(Fig. 12)

Lectotype description

Thallus brownish (herbarium), lobate, apparently loosely adnate (pasted in a paper card), corticicolous, 12.5 cm broad. *Lobes* irregularly branched, more or less crowded, 2.0–7.5 mm wide, *surface* continuous to cracked, smooth to irregularly pitted (i.e., with small depressions), lustrous, becoming strongly cracked in the center; apical zone rounded; margin crenate, plane to undulated. *Lacinules* simple to dichotomous, localized mainly in the center of the thallus, usually canaliculated and "closing" (i.e., joining the margins and becoming solid) from the apices to the bases, apex acute and with a black tip when esorediate, capitate to extensive and finally "T-like" when sorediate, 0.5–4.0 (–7.5) × 0.2–1.0 mm; undersurface cream color, erhizinate or with sparse rhizinae. *Maculae* distinct, reticular, laminal, originating cracks. *Cilia* black, simple or rarely subsquarrose, 0.2–1.5 × 0.02–0.04 mm, few. *Soralia* capitate to sometimes growing

backwards, on the lacinules apices; *soredia* subgranular to farinose. *Isidia* and *pustules* absent. *Medulla* white. *Undersurface* (difficult to analyze, since the thallus is pasted in a paper card) black, lustrous, slightly rugose to papillate; *marginal zone* brown to dark brown, lustrous, 2.5–3.0 mm wide, naked to more usually rhizinate, with an attenuated limit, papillate; *rhizines* black, simple or sometimes squarrose, up to 3 mm long, ca. 0.05 mm wide, abundant, distributed in groups.

Apothecia absent. *Pycnidia* laminal, mainly on the lacinules, conspicuous, frequent, ostiole black; *conidia* filiform, 7.5–12.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema clavuliferum* is recognized by the reticular maculae and the abundant closed lacinules with the soralia at the apices.

Some authors already realized that it is different from *P. reticulatum* (e.g. Streimann 1986, Kurokawa 1991, Moon *et al.* 2001, Elix 2001, Killmann & Fischer 2005), while others (e.g. Awasthi 1976, Divakar *et al.* 2001) reached the conclusion that it is conspecific with *P. reticulatum*. Based on the types here studied, we can only conclude they are two distinct species.

The lectotype (H) is well-preserved and developed. The cilia are very few. However, many rhizinae protrude from the lower surface, and look like cilia. The thallus is pasted on a paper card, so the description of the undersurface was not complete. Although a small portion of one thallus, also numbered “2” like the major one, is pasted by the upper surface, it is difficult to assign it *Parmelia clavulifera* on the absence of lacinules. So we preferred to take the data just from the bigger thallus.

The correct information from the types are not clear. Räsänen (1944) asserted that the collections were from Tahiti, made by Dr. med. Bouffon or E. Vieillard. Hale & Fletcher (1990) also listed Tahiti, but just Vieillard as the collector. In the lectotype packed there is an annotation by T. Ahti, dated February 2002, indicating that the collector is probably E. Vieillard, and the locality is possibly New Caledonia.

The paratype (H) is represented by a more laciniate, robust thallus (the lectotype is more delicate), with rhizines strongly squarrose-branched. The cilia also are more distinctly squarrose than that of the lectotype. The lacinules are similar, however, and clearly assigns this species within the circumscription of *Parmelia clavulifera*.

Several records from Brazil (e.g. Spielmann 2005, Benatti 2005 and Jungbluth 2006) were based on different lichens that were not yet studied in detail. Actually they can represent a different, although widely distributed species (see comments under *P. cetrata* f. *sorediifera* in the *Nomina inquirenda*).

Distribution: Oceania (Lamb 1963, Feuerer 2008), Asia (Feuerer 2008), Hawaii (Moon *et al.* 2001) and Brazil (Barros & Xavier Filho 1972).

***Parmotrema concors* (Kremp.) Spielmann & Marcelli, comb. nov.**

Parmelia concors Kremp., Verhandlungen der zoologisch-botanischen Gesellschaft in Wien 30: 329-342. 1881. –Type: Australia, Kings Island, on bark, leg. *Neate* s.n. (holotype: M!).

(Fig. 13)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, corticicolous, 9.0 × 7.0 cm. *Lobes* irregularly branched, crowded, (2.5–) 4.0–7.0 mm wide, *surface* continuous or subscrobiculate, sometimes cracked, smooth, lustrous, becoming strongly cracked in the center; apical zone rounded; margin crenate to sublacinulate, undulated. *Lacinules* hardly distinct, often simple or bifurcate, sometimes spatulate, localized mainly in the thallus center, usually plane, apex rounded or acute, 1.0–2.5 × 0.5–2.0 mm. *Maculae* distinct, effigurate, laminal, forming dense groups and sometimes assuming an reticular look in the lobe apices. *Cilia* black, often stout and spiky, straight of curved, simple to furcated, 0.2–1.5 × 0.02–0.1 mm, abundant. *Pustules* and *isidia* absent. *Soralia* usually brown, labriform to growing backwards, usually subapical and submarginal turning lobes margins involute, or in the lacinules apices, or sometimes orbicular and laminal; *soredia* granular. *Medulla* pale salmon (maybe herbarium color – possibly white when fresh). *Undersurface* black, lustrous, rugose, papillate, with cracks; *marginal zone* dark brown, lustrous, 1.0–3.0 mm wide, naked, with a attenuated limit, smooth to rugose or finely papillate; *rhizines* black or sometimes with brown apices, simple or rarely branched, slender or thickened, 0.2–2.0 × 0.01–0.15 mm, abundant, almost evenly distributed.

Apothecia unknown. *Pycnidia* not found, although numerous black, submarginal spots are present, yet without conidia.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema concors* can be distinguished by the effigurate maculae, the naked under margin and the spiky, often furcated cilia.

This species was treated as a synonym under *P. reticulatum* (Hale & Fletcher 1990). Nevertheless, the effigurate maculae, the thickened, often bifurcate cilia, and the dimorphic rhizines, leave no doubt that it's a typical *Canomaculina* in the Elix (1997) sense. It has also a distinct naked brown marginal zone. *Parmotrema reticulatum* has slender cilia, sometimes with a small lateral branch, but not furcated at all, and a rhizinate marginal zone, with a very narrow brown naked margin.

Known distribution: Australia (Krempelhuber 1881, Hale & Fletcher 1990).

Parmotrema concurrens **Hale**
Mycotaxon 5 (2): 432. 1977.

Type: Brazil, Pernambuco State, Brique, May 1970, saxicolous, leg. *L. Xavier Filho* 752 (holotype: US!).

(Fig. 14)

Holotype description

Thallus grayish, lobate, loosely adnate, saxicolous, pieces up to 5 cm broad. *Lobes* irregularly branched, laterally overlapped to ± crowded, 3–10 mm wide, *surface* continuous, smooth, sublustrous to opaque, sometimes becoming irregularly cracked in the center; apical zone rounded; margin crenate to sublacinulate, undulated. *Maculae* absent. *Cilia* black, simple, up to

1 mm long, 0.02–0.05 mm wide, few. *Lacinules*, *pustules* and *soredia* absent. *Isidia* concolor to the thallus, apex dark brown to black, usually simple, sometimes branched or aggregated in small coralloid formations, up to 0.3 mm high, 0.05–0.20 mm wide, erect, firm to friable, apex rarely ciliate, laminal to marginal. *Medulla* white. *Undersurface* black, opaque, usually finely rugulose, less frequently smooth or papillate, with cracks; *marginal zone* brown or rarely pale brown, sublustrous, 1–4 mm wide, naked, with an attenuated limit, smooth, papillate or slightly rugose; *rhizines* black, simple or rarely furcated or irregularly branched, up to 2 mm long, 0.02–0.10 mm wide, frequent, distributed in groups.

Apothecia absent. *Pycnidia* submarginal or laminal, conspicuous, with or without prominent margin, frequent, ostiole black; *conidia* short-filiform, 6–10 × ca. 1 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor), gyrophoric acid (minor), hypoconstictic acid (minor), norhypoconstictic acid (minor).

Remarks: *Parmotrema concurrens* is characterized by the isidiate thallus without maculae and the combination of salazinic acid, gyrophoric acid and hypoconstictic acid and allied in the medulla.

The similar *P. ultralucens* can be distinguished by the presence of lichexanthone (medulla UV+ yellow) and absence of gyrophoric acid. It also can resemble some saxicolous *P. tinctorum* (Nyl.) Hale with narrow lobes, although not related at all, since this last species is eciliate and has lecanoric acid.

The holotype collection is formed by several thalli, or parts of the same thallus. Hale (1977) reported in the protologue thallus 5–8 cm broad, however it is possible he included measurements from the additional specimens examined. The medulla is slightly rose in some areas, perhaps an effect of the decomposition of the salazinic acid.

Distribution: Venezuela (Feuerer 2008), and Brazil, where it was reported to Pernambuco State (Hale 1977).

Parmotrema coralliforme (Hale) Hale

Phytologia 28 (4): 335. 1974.

Parmelia coralliformis Hale, Contributions from the United States National Herbarium 36 (5): 324. 1965. – Type: Mexico, State of Chiapas, Mature pine forest on mountainside, 2340 m alt., 18 Km southeast of San Cristóbal on highway 190, on deciduous tree, 24.III.1960, leg. *M.E. Hale* & *T.R. Soderstrom* 20287 (holotype: US!; isotypes: REN, S!).

(Fig. 15)

Holotype description

Thallus pale brownish (herbarium), lobate, loosely adnate, corticicolous, 12.5 cm broad. *Lobes* irregularly branched, laterally overlapped to crowded, 3–12 mm wide, *surface* continuous, smooth, lustrous, becoming cracked towards the center; apical zone rounded; margin broadly crenate to incised, undulated. *Maculae* distinct, effigurate, laminal, originating effigurate cracks. *Cilia* black, simple to sometimes furcated or rarely dichotomous, up to 1.5 mm long, sometimes very thick, 0.04–0.15 mm, abundant. *Lacinules* forming *arbuscular structures* up to 10 mm high, coralloid-branched, branches flattened to terete, usually ciliate, surface scrobiculate, not

sorediate but with abundant nodules specially in the apices. *Pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* (based in the S isotype): dark brown, lustrous, smooth to papillate or rarely with inconspicuous veins, without cracks; *marginal zone* yellowish brown, lustrous, 2–12 mm wide, rhizinate, with an attenuated limit, smooth; *rhizines* black, simple to squarrose, up to 1 mm long, thin, 0.01–0.05 mm wide, abundant, evenly distributed.

Apothecia absent. *Pycnidia* submarginal or rarely laminal, conspicuous, without prominent margin, frequent, ostiole black; *conidia* not found (ca. 30 pycnidia examined).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema coralliforme* is distinguished by the arbuscular structures, which are usually ciliate and esorediate, the effigurate maculae and the pale brown and rhizinate marginal zone in the undersurface.

It can be compared with *P. ramusculum*, which develops eciliate and strongly sorediate arbuscular structures, has punctiform maculae, sparse cilia (abundant in *P. coralliforme*) and the black naked marginal undersurface. See under *P. ramusculum* comments about other species.

In *P. coralliforme*, the effigurate maculae give rise to distinct cracks, also effigurate. This phenomenon is not common in the species here investigated, since the cracks are usually irregular or reticular, independent from the type of macula.

The arbuscular structures sometimes break, exposing the white medulla, but true soredia are totally absent.

The isotype (S) agrees well with the holotype. It has more ciliate fascicular structures and, as the holotype, abundant pycnidia; however, no conidia were found. Since the holotype is glued to a card, the isotype was used to describe the underside.

Distribution: Guianas (Sipman 1999) and Mexico (Hale 1965).

Parmotrema cristiferum **(Taylor) Hale**
Phytologia 28 (4): 335. 1974.

Parmelia cristifera Taylor, London Journal of Botany 6: 165. 1847. – Type: India, Calcutta, *Wallich* s.n. (lectotype: FH!).

= *Parmelia perforata* var. *ulophylla* Meyen & Flotow, *Novorum Actorum Academiae Caesareae Leopoldino-Carolinae Naturae Curiosum* 19, suppl. 1: 218. 1843. – Type: Hawaiian Islands, Oahu (lectotype: G!).

= *Parmelia hildebrandtii* Kremp., Linnaea 41: 139. 1877. – Type: Comoro Islands, Johanna Island, 400 m. alt., an der Rinde Von Bäumen (besonders *Cycas*), an hehten stellen im Walde, leg. *Hildebrandt* 1866c (holotype: M!; isotypes: BM!, K!).

= *Parmelia mesotropa* Müll. Arg. f. *sorediosa* Müll. Arg., *Flora* 74: 377. 1891. – Type: India, Cachar, leg. *Keenan* (holotype: G!).

(Figs. 16-17)

Lectotype description

Thallus cream, lobate, apparently loosely adnate, 16 × 14 cm. *Lobes* strongly undulated, irregularly branched, laterally overlapped and difficult of to distinguish one from the other, 10–18 mm wide., *surface* usually cracked; apical zone rounded and crisped; margin strongly sorediate and crispate-undulated. *Maculae* absent. *Soralia* whitish, linear continuous or interrupted, sometimes labriform, mainly marginal, although some present in thalline crests, rarely orbicular or capitate, or in small "columns"; *soredia* farinose to granular. *Lacinules*, *cilia*, *pustules* and *isidia* absent. *Medulla* white or with the upper part slightly rose (maybe because the eumitrins). *Undersurface* black, lustrous, strongly papillate, with scars; *marginal zone* absent or cream under the soralia, opaque, 1–2 mm wide, naked, with a sharp limit, smooth or rugose; *rhizines* black, simple, up to 1 mm long, few, distributed in groups.

Apothecia concave, small (up to 2.5 mm in diameter), substipitate, laminal, margin smooth, sorediate, amphithecium sorediate, disc brown, epruinose, imperforate; *ascospores* ellipsoid, 24–35 × 12–20 µm, episporium 2–3 µm. *Pycnidia* apparently rare (there are several black spots that remember pycnidia, however without any tissue inside); *conidia* not found (ca. 30 pycnidia studied).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC (J.A. Elix, 28.X.1998, label with the holotype in FH): atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (trace), eumitrin A1 (minor), eumitrin A3 (trace), unknowns (minor/trace).

Remarks: *Parmotrema cristiferum* is characterized by the upper cortex with atranorin, linear marginal soralia, sublageniform conidia and large ascospores (24–35 × 12–20 µm). It is a usually eciliate species, although cilia can rarely be found in some specimens.

It can be compared with *P. stuppeum* that also develops marginal soralia and sublageniform conidia, but otherwise has smaller ascospores (12–17 × 6–9 µm, fide Hale 1965).

Parmelia cristifera was first proposed by Taylor (1847), who cited four specimens, without designating the type. They are, therefore, syntypes: "Calcutta, *Wallich*; Mauritius, *Dr. Wright*; Brazil, *Gardner*; Demerara, *Mr. Parker*". Krog & Swinscow (1981) already dealt with this difficulty, and it seems appropriate to see each specimen separately:

- India, Calcutta, *Wallich* s.n., was selected as the lectotype of *Parmelia cristifera* (see Berry 1941, Dodge 1959 and Hale 1965).
- Brazil, *Gardner*, is the holotype of *Parmelia gardneri* C.W. Dodge (Dodge 1959).
- Mauritius, *Dr. Wight* (not "Wright" as cited in the protologue) represents one syntype of *Parmelia cristifera*. And, at the same time, is one specimen cited in the protologue of *Parmelia sieberi* (Dodge 1959).
- Demerara (Guyana), *Mr. Parker*, is not *Parmelia cristifera*, since the salazinic acid is lacking (medulla K–). There's a label from Krog pointing out the existence of only fatty acids (TLC), and another one from Hale (May 08, 1959), determining this species as *Parmelia sanctae-crucis*. Krog & Swinscow (1981) asserted that it belongs to *Parmelia praesorediosa*.

Seemingly the first author to choose the specimen *Wallich* s.n. (FH!) as lectotype was Berry (1941). He left a label (signed E.C.B.) in 1938, pointing this. Nevertheless, the ascospores measures (6–8 × 2–4 µm) published in 1941 are certainly a typographical error, since so small ascospores are not known in *Parmotrema*.

Lindsay (1866) made comments about the Gardner specimen from Brazil, i.e., *Parmotrema gardneri* (Dodge) Hale. Müller Argoviensis (1888) asserted that Calcutta specimen was sterile, while the Brazilian one, fertile. However, the two types (FH!) are clearly fertile. Merrill (1909)

reported *Parmelia cristifera* to the United States and Hawaii, distinguishing it of *P. latissima* Fée.

Lynge (1914), when describing Malme's collections from Mato Grosso State, Brazil, found ascospores with 22–27 × 10.5–14 µm, with an episporium 2 µm wide. These are little smaller than that published by Hale (1965): 26–35 × 13–18 µm, episporium 3–4 µm.

Lamb (1963) cited one variety and two forms to *Parmelia cristifera*: *P. cristifera* var. *abissinica* Cengia Sambo is actually *Flavopunctelia flaventior* (Stirton) Hale (Hale 1980, Hale & DePriest 1999). *Parmelia cristifera* f. *pallida* Räs. is a synonym of *Parmotrema perlatum* (Hale 1965) and finally *P. cristifera* f. *cinerata* Zahlbr. corresponds to *Parmotrema cristiferum* (Hale 1965).

This is one of the cases where Hale (1965) choose illustrate additional specimens examined instead the type material, one from Mexico (Hale 20073, Fig. 5) and the other from Formosa (Taiwan) (*Ogata* s.n., Fig. 16). These were not asked on loan. Even so, we prefer to choose the lectotype from FH to illustrate here.

The type is glued by the underside, so only some marginal zones were studied.

We failed in find conidia in the lectotype. Vainio (1909a) observed that "*Secundum specimen no. 35399 in herb. Nyl. var. cristifera apotheciis instructa est cupuliformibus, breviter pedicellatis, imperforatis, disco testaceo rufo, sporis long. 0,026-0,032 mm., crassit. 0,015-0,018 mm, pycnoconidiis sublageniformibus, long. 0,005-0,007 mm., crass. 0,001 mm (secund. annot. Nylanderi in specimine a Jardin lecto e loco incerto)*".

It is difficult to know the substrate of the syntypes. The protologue (Taylor 1847) gives no indication.

Notes about accepted synonyms

Parmelia perforata var. *ulophylla* Meyen & Flotow

We have studied from G Herbarium two specimens. One is sorediate ("A"), sterile, with strongly crisped lobes and occasional cilia (up to 0.5 mm long) in one part of the thallus. So it clearly matches with *Parmotrema cristiferum*, when compared with the lectotype (FH!). The occasional cilia were realized by Meyen & Flotow (1843).

The second thallus ("B") has two imperforate apothecia, reticular maculae and cracks, being a *Rimelia* with salazinic acid (medulla K+ yellow → red). There is an anonymous annotation of the ascospores (14–17 × 8–11 µm), confirming they are very different from those of *P. cristiferum*. The actual status of this specimen remains unclear and was not further investigated here, since it is in a poor condition.

Parmelia hildebrandtii Kremp.

Krempelhuber (1877) described *P. hildebrandtii* with ascospores 11–15 × 11–12 µm. This size is very distant from the known in *Parmotrema cristiferum*. Krog & Swinscow (1981) already wondered about the identity of this species and pointed out it could be compared with *P. stuppeum* on the ascospores size basis.

Hale (1965) stated that are isotypes in BM and K, but do not indicated the location of the holotype, and was in this mode of citation followed by Winnem (1975). Actually, the holotype of *P. hildebrandtii* is located in M, as we discovered after consultation of the curator, Dr. Andreas Beck. It is a well-developed specimen, composed by three thalli, two of them certainly part of the same thallus, and the third part with several apothecia (as indicated by Krempelhuber 1877). Seven attempts to find ascospores were made in the more mature apothecia, but fruitless. Conidia, however, are sublageniform, 5–7 × ca. 1 µm, so matching the conidia of *P. cristiferum*. In the exsiccate Krempelhuber left a drawing of the asci with ascospores inside, only two outside. The sizes given are 11–15 × 11–12 µm.

In the apothecium from the K specimen the hymenium is strongly guttulate and little developed, since only few ascospores were found, some clearly immature. They are 20–29 × 10–14 µm, the episporium 2–2.5 µm, close to the accepted to *P. cristiferum*. If new collections from the type localities become available in the future, maybe the difference in the ascospores sizes will be still smaller or absent.

Unfortunately the pycnidia are absent in the K specimen. The specimen from BM has submarginal pycnidia with sublageniform conidia 6.5–8.5 × ca. 1 µm, agreeing to the accepted for *Parmotrema cristiferum* and equal to that found in the holotype of *P. hildebrandtii*.

In conclusion, probably Krempelhuber found immature ascospores, and therefore *Parmelia hildebrandtii* is synonym of *Parmotrema cristiferum*.

With the BM specimen there's an annotation made by B. Winnem, dated 22.II.1974, informing that atranorin and salazinic acid were found (TLC).

Parmelia hildebrandtii Kremp. f. *sorediosa* Müll. Arg.

Hale (1965) referred this synonym with one lectotype in G and one isotype in K. The curator of K Herbarium informed that some specimens were not sent because could be deposited at the Natural History Museum.

The specimen received from G consists in a small, sorediate thallus with sublageniform conidia, 5–8 × ca. 1 µm. It is morphologically similar to *P. cristiferum*, and thus we agree with the synonymization proposed by Hale (1965). However, the K specimen could provide additional evidences.

Parmelia mesotropa Müll. Arg. f. *sorediosa* Müll. Arg. (Fig. 17)

Hale (1965) asserted that the holotype of this taxon would be deposited in K, while the isotype in G. We have received two specimens from these herbaria. The specimen in G is labeled as holotype (contrary to the information given in Hale 1965). Morphologically and chemically it agrees well with the lectotype of *P. cristiferum*, and so is accepted here as belonging to it. The chemistry was reported in a label by Elix (3.X.1998), through TLC in solvent C and HPLC: atranorin (major), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), eumitrin A1 (trace), eumitrin A3 (trace).

The specimen from K sent to us has marginal soredia and a naked under margin, clearly a *Parmotrema*, without cilia. The cortex is K+ yellow, UV–, the medulla K–, C+ red, KC+ red, P–. Since it has lecanoric acid, probably belongs to *Parmotrema austrosinense* (Zahlbr.) Hale. The conidia are filiform, 9–13 × ca. 1µm. There's no annotation from Hale, so maybe he don't saw this specimen. There's also no indication if this is a type or not.

Therefore, by the moment we are accepting the G specimen as the holotype. It is possible that the real type was not sent and is preserved in K Herbarium. This needs to be further checked.

Distribution: Africa (Hue 1899, Hale 1965, Krog & Swinscow 1981), Asia (Taylor 1847, Vainio 1909a, Hue 1899, Hale 1965, Chen *et al.* 2005, Divakar & Upreti 2005), Oceania (Merrill 1909, Hue 1899, Hale 1965, Elix 1994, Louwhoff & Elix 1998), North America (Merrill 1909, Berry 1941, Hale 1965, Brodo *et al.* 2001), Central America (Hue 1899, Hale 1965) and South America (Hue 1899, Hale 1965). In South America it is known to Brazil, British Guiana, Colombia, Peru, Surinam and Venezuela (Hale 1965). In Brazil it was recorded to the States of Minas Gerais (Zahlbruckner 1905), Mato Grosso (Lynge 1914), Minas Gerais (Zahlbruckner 1905), Paraná (Donha 2005) and São Paulo (Zahlbruckner 1909, Hale 1965).

Parmotrema cristobaliae **(Ferraro & Elix) Blanco, Crespo, Divakar, Elix & Lumbsch** Mycologia 97 (1): 157. 2005.

Rimeliella cristobaliae Ferraro & Elix, Mycotaxon 49: 406. 1993. – Type: Argentina, Corrientes Province, Depto. Ituzaingó, Rincón Ombú Chico, leg. *L.I. Ferraro*, *S. Tressen*, *A. Schinini* & *M. Gonzales* 687, 25.IV.1975 (holotype: CTES!).

≡ *Canomaculina cristobaliae* (L.I. Ferraro & Elix) Elix, *Mycotaxon* 65: 477. 1997.

(Fig. 18)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, corticicolous, 10.5 cm broad. *Lobes* irregularly branched, ± crowded, 3–10 mm wide, *surface* continuous to cracked, smooth to notched, lustrous, becoming reticulate cracked towards the center; apical zone rounded to abundantly lacinulate; margin deeply crenate to sublacinulate, undulated. *Maculae* distinct, effigurate, although sometimes assuming a pseudo-reticular aspect, laminal, originating cracks or not. *Cilia* black, simple to rarely squarrose or furcated, usually short, up to 0.7 mm long, 0.02–0.04 mm wide, abundant. *Lacinules* irregularly branched to subdichotomous, present in the whole thallus, plane to slightly convex, apex rounded, truncate or acute, 2–7 × 1–6 mm. *Isidia*, *soredia* and *pustules* absent. *Medulla* white. *Undersurface* black, lustrous, smooth or papillate, with cracks; *marginal zone* brown to dark brown, lustrous, 1–3 mm wide, rhizinate and papillate, with an attenuated limit; *rhizines* black, dimorphous, short rhizines simple, up to 0.5 mm long, 0.01–0.04 mm wide, abundant, evenly distribute, long rhizines usually subsquarrose to irregularly branched, up to 2 mm long, 0.04–0.06 mm wide, frequent, distributed in groups.

Apothecia ± plane, 6–10 mm in diameter, stipitate, margin smooth to slightly incise, undulated, amphithecium maculate, rugose, disc brown, epruinose, perforate; *ascospores* ellipsoid, 12–14 × 7.5–9.0 µm, episporium 1.0–1.5 µm. *Pycnidia* laminal or more commonly submarginal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* filiform, 9–14 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC: atranorin, chloroatranorin, salazinic acid (major), norlobaridone (major), consalazinic acid (minor/trace), loxodin (minor/trace) (Ferraro & Elix 1993).

Remarks: *Parmotrema cristobaliae* is distinguished by the strongly lacinulate thallus without vegetative propagules, the effigurate maculae, dimorphic rhizines and the production of salazinic acid and norlobaridone.

Together the effigurate maculae, this species also presents pseudo-reticular ones. Since it has a black undersurface (common in *Rimelia*), not brown as usual in *Rimeliella*, it could well link between these formerly recognized genera.

Ribeiro (1998) reported *P. cristobaliae* to MG, Brazil. However, the study of the specimen Marcelli & Yano 23972 (SP) shows that it belongs to another taxon, probably *P. subcaperatum*. In this way, *P. cristobaliae* remains known only to Argentina and Bolivia.

The holotype from CTES is a good specimen, fertile and fully lacinulate. The apothecia are variably damaged, giving the idea of an old thallus. Also some features of the lobes are difficult to evaluate since the thallus is, for the most part, covered by the lacinules.

The correct orthography of the specific epithet is "*cristobaliae*" instead of "*cristobalii*", as pointed out by Ribeiro (1998) and Hale & DePriest (1999). It follows the Article 60.11 and Recommendation 60C.1 of the *Vienna Code*.

Distribution: in South America it was recorded to Argentina (Ferraro & Elix 1993) and Bolivia (Ferraro & Elix 1993).

Parmotrema delicatulum **(Vainio) Hale**
Phytologia 28 (4): 335. 1974.

Parmelia delicatula Vainio, Acta Societatis pro Fauna et Flora Fennica 7 (1): 35. – Type: Brazil, Minas Gerais State, [Municipality of] Catas Altas, Caraça [nowadays Parque Natural do Caraça], 1885, leg. *Vainio* (holotype: TUR-V! isotypes: BM!, FH!, M, UPS).

= *Parmelia radians* Lynge, Arkiv för Botanik 13 (13): 85. 1914. – Type: Brazil, Minas Gerais State, Municipality of São João d'el Rey [del Rei], leg. *G.O.A. Malme* 203 (holotype: S!; isotype: MO).

(Fig. 19)

Holotype description

Thallus yellowish, blackening toward the centre, sublaciniate, loosely adnate, saxicolous, 4.5–5.0 cm broad. *Sublaciniae* irregularly branched, contiguous with laterally overlapped or crowded margins, 1.0–3.5 mm wide, *surface* continuous, smooth, lustrous, becoming cracked in the center; apical zone rounded, or subtruncate; margin crenate to sublacinulate, undulated. *Cilia* black, simple or sometimes furcated, 1.5–2.8 × 0.03–0.10 mm, abundant in the young regions. *Lacinules*, *maculae*, *pustules*, *soralia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, smooth, papillate or slightly rugose, with numerous scars; *marginal zone* usually absent, i.e., black, or rarely dark brown, lustrous, 1.0–1.2 mm wide, naked, smooth or with few papillae; *rhizines* black, simple or rarely furcated next to the apex, 0.2–1.5 × 0.01–0.05 mm, frequent, irregularly distributed.

Apothecia cupuliform, 1.3–4.3 mm in diameter, substipitate, submarginal, margin smooth or slightly crenate with small incisions, amphithecium smooth, pruinose, maculate, eciliate, disc dark brown, epruinose, imperforate; *ascospores* ellipsoid, 11–12.5 × 7.5–9.0 µm, episporium 0.5–1.0 µm. *Pycnidia* submarginal, rarely laminal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* short-filiform, straight or slightly curved, 7.5–9.0 × ca. 0.5 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC (J.A. Elix, 07.V.1996, label with the holotype in TUR-V): usnic acid (minor), salazinic acid (major), consalazinic acid (minor), gyrophoric acid (minor), hypoconstictic acid (minor), lecanoric acid (trace).

Remarks: *Parmotrema delicatulum* can be recognized by the yellowish thallus (usnic acid) composed of narrow sublaciniae (1.0–3.5 mm wide) and developing long cilia. The closest species is *P. magnum*, distinguished by the wider lobes (5–15 mm), shorter cilia (up to 1.5 mm) and the abundance of medullar gyrophoric acid (C+ rose). Additionally, the amphithecia are smooth in *P. delicatulum* and strongly rugose in *P. magnum*.

The holotype of *P. delicatulum* has the upper surface blackening towards the centre, but it seems derived from the herbarium preservation or the age of the specimen.

The BM isotype agrees well with the features of the holotype, but only immature ascospores were found. The isotype from M was not found by the curator, and could be on loan (A. Beck, pers. comm.). According to Hale (1965), there's an isotype of *Parmelia delicatula* in UPS, however, this specimen was not sent to us, and only a picture could be seen.

The holotype of *Parmelia radians* has a strongly pruinose upper surface, cilia more commonly furcated and a more plane and adnate thallus than *Parmotrema delicatulum*. His chemical study (TLC in solvent C, HPLC – J.A. Elix, 10.V.1996) revealed the presence of usnic acid (minor), salazinic acid (major), consalazinic acid (minor) and hypoconstictic acid (trace). This profile makes it also more similar to *P. delicatulum* than to *P. magnum*, which contains gyrophoric acid (major) and does not produces hypoconstictic acid. Its conidia are short-filiform, 6–9 × 1 µm, matching both *P. delicatulum* and *P. magnum*. Unfortunately, apothecia are not known in *P. radians*, so that no additional features could be compared and we are accepting this taxon as synonym of *P. delicatulum*, by the moment.

As far as we know, this is the first publication illustrating the type of *Parmelia delicatula*.

Distribution: South America, where is reported to Argentina (Osorio 1981), Brazil (Zahlbruckner 1909, 1930a; Hale 1965; Fleig 1997), Paraguay (Osorio 1970), Uruguay (Hale, 1965) and Venezuela (Feuerer 2008). In Brazil it is known to the States of Mato Grosso do Sul (Fleig & Riquelme 1991), Minas Gerais, Paraná, Rio de Janeiro (Hale, 1965) and Rio Grande do Sul (Spielmann 2006).

Parmotrema elixii **Spielmann & Marcelli, nom. nov.**

Type: Australia, Western Australia, Mt Clarence, Albany, 35°02′S. 117°54′W, 230 m alt., dry sclerophyll forest with large granite outcrops, on shaded granite ledges, 15.IX.1994, leg. *J.A. Elix*, *H.T. Lumbsch* & *H. Streimann* 41377 (holotype: CANB; isotype: CANB!, HO, PERTH!).

= *Rimelia pustulata* Elix & Bawingan, Mycotaxon 81: 252. 2002.
≡ *Parmotrema pustulatum* (Elix & Bawingan) O. Blanco, A. Crespo, Divakar, Elix & Lumbsch, Mycologia 97 (1): 157, 2005, non *Parmotrema pustulatum* Louwhoff & Elix, Mycotaxon 75: 199. 2000.

(Fig. 20)

Isotype description (CANB)

Thallus brownish (herbarium), lobate, loosely adnate, saxicolous, 6–9 cm broad. *Lobes* irregularly branched, ± crowded, 2–10 mm wide, *surface* continuous or cracked, smooth or slightly rugose, lustrous, becoming rugose and reticulate cracked towards the center, in some areas the areolae flaking off; apical zone rounded; margin smooth to crenate or sublacinulate, undulated. *Maculae* distinct, reticular, laminal, originating cracks. *Cilia* black, simple, short, up to 0.5 mm long, 0.02–0.05 mm wide, frequent. *Lobules* spatulate**,** frequently formed from the pustules, 0.5–2.0 × 0.4–1.5 mm. *Pustules* ± capitate, usually forming dense agglomerations, laminal and submarginal, originating soredia-like structures. *Lacinules*, *isidia* and *true soredia* absent. *Medulla* white. *Undersurface* black, lustrous, usually papillate or rugose, with cracks; *marginal zone* dark brown, lustrous, 1–3 mm wide, rhizinate, with an attenuated limit, papillate; *rhizines* black, simple to branched, up to 1.5 mm long, 0.02–0.10 mm wide, frequent, irregularly distributed.

Apothecia unknown. *Pycnidia* immature, submarginal, inconspicuous, without prominent margin, rare, ostiole black; *conidia* not found (10 pycnidia examined).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC (J.A. Elix, 07.XI.2002, label with the isotype in CANB): atranorin (minor), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema elixii* is distinguished by the reticular maculae, the medulla with salazinic acid, short cilia (up to 0.5 mm long) and principally by the production of pustules, usually forming dense agglomerations.

It can be compared with *P. granulare* that has also reticular maculae but otherwise distinct lacinules with individualized pustules (i.e., not forming agglomerations), and *P. anchietanum* Benatti, Marcelli & Elix (see Benatti *et al.* 2008), characterized by the narrow (1–3 mm) and lacinulate lobes

The new name *P. elixii* is here being proposed to the species earlier known as *Rimelia pustulata* Elix & Bawingan (Elix *et al.* 2002). That species is clearly different from *Parmotrema pustulatum* Louwhoff & Elix (Louwhoff & Elix 2000), which is emaculate and without salazinic acid. When Blanco *et al.* (2005) synonymized the genus *Rimelia* under *Parmotrema*, they proposed the combination "*Parmotrema pustulatum* (Elix & Bawingan) O. Blanco, A. Crespo, Divakar, Elix & Lumbsch" to *Rimelia pustulata*, so creating a later homonym and, therefore, the necessity of a new name.

We did not have access to the holotype, however CANB sent an isotype. It is well developed and all features could be described. In the isotype from PERTH, however, the underside was not studied, since the lichen is glued to a paper card. Even so, it agrees well with the CANB isotype.

Distribution: Australia (Elix *et al.* 2002), Philippines (Elix *et al.* 2002).

***Parmotrema enteroxanthum* Hale**
Mycotaxon 5 (2): 434.1977.

Type: Venezuela, Merida, La Carbonera, sector El Pedregal, on rocks in open pasture, 2100 m Alt., 19-III-1975, leg. M.E. Hale & M. Lopez Figueiras 44177 (holotype: US; isotypes: MERF, UPS!).

(Fig. 21)

Isotype description (UPS)

Thallus whitish-grey, lobate, loosely adnate, saxicolous, 9 cm broad; *lobes* irregularly branched, crowded, 0.5–1.3 mm wide, *surface* continuous to irregularly cracked, sometimes flaking off some parts of the upper cortex, smooth, lustrous to opaque, becoming cracked in the center; apical zone rounded; margin smooth or irregular, undulated. *Maculae* and *cilia* absent. *True isidia* absent. *Dactyloid structures* concolor to the thallus, simple to coralloid, up to 1 mm high, usually thick and inflated, 0.2–0.8 mm wide, erect, firm or friable, then leaving a yellow tuft of medulla, apex eciliate *Pustules* laminal, extensive, giving raise to schizidioid or dactyloid structures. *Lacinules* and *soredia* absent. *Medulla* entirely yellow or more frequently only the under portion. *Undersurface* black, lustrous, smooth, slightly rugose or papillate, rarely veined, strongly cracked; *marginal zone* absent (black) or pale to dark brown, lustrous, 1.5–4.0 mm wide, naked, with an attenuated to sharp limit, smooth; *rhizines* black, simple or rarely branched, up to 1.5 mm long, 0.01–0.10 mm wide, frequent, distributed in groups.

Apothecia cupuliform, 1.0–7.5 mm in diameter, stipitate, laminal to submarginal, margin crenate to incised, usually involute, amphithecium smooth to strongly pustulate, emaculate or

with faint maculae, disc brown, epruinose, imperforate; *ascospores* ellipsoid to slightly reniform 30–35 × 14–19 µm, episporium 2.5–4.5 µm. *Pycnidia* mainly submarginal, conspicuous, without prominent margin, abundant, ostiole black; *conidia* sublageniform, 5.0–6.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor)
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Remarks: *Parmotrema enteroxanthum* can be recognized by the yellow medulla (at least the inferior portion), swollen and dactyloid isidia, sublageniform conidia and large ascospores (30–35 µm long).

The holotype collections from US was not sent to us, the same with the isotype from MERF. The isotype in UPS is composed of two parts which, presumably, are part of one single thallus. But it is interesting to note that one part has well developed isidia, while the other not. In the other features, however, the two parts are identical, including the yellow medulla and large ascospores.

As far as we know, there are no other species of *Parmotrema* with salazinic acid and yellow medulla.

Distribution: Colombia (Aguirre-C & Rangel-CH 2007), Venezuela (Hale 1977).

***Parmotrema erubescens* (Stirton) Krog & Swinscow**
The Lichenologist 15 (2): 127-130. 1983.

Parmelia erubescens Stirton, Scottish Naturalist 4: 201. 1878. – Type: Queensland, near Brisbane, leg. *F.M. Bailey* 11 (lectotype: BM!, selected here).

≡ *Canomaculina erubescens* (Stirton) Elix, Mycotaxon 65: 477. 1997.

(Fig. 22)

Holotype description

Thallus brown reddish (herbarium), lobate, loosely adnate, 3–4 cm broad. *Lobes* irregularly branched, laterally overlapped, 2–10 mm wide, *surface* continuous, smooth to scrobiculate, lustrous, becoming rugose, cracked and more deeply scrobiculate towards the center; apical zone rounded; margin broadly crenate to incised, undulated. *Maculae* distinct, effigurate, sometimes the irregular dots connecting in pseudo-reticular formations, laminal, originating cracks or not. *Cilia* black, simple or rarely furcated, up to 2 mm long, thin to thickened 0.02–0.06 mm wide, abundant. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* light brown or blackish brown only in the very centre, lustrous, smooth to papillate, without cracks; *marginal zone* absent; *rhizines* black, dimorphic, the shorter ones simple to furcated or less frequently squarrose, up to 0.5 (–1.0) mm long, thin, 0.01–0.05 mm wide, abundant, evenly distributed; the longer ones up to 1.5 mm long, thickened, 0.05–0.10 mm wide, simple or branched, apparently frequent and distributed in groups.

Apothecia absent (according to Elix 1997, ascospores 10–12 × 8–10 µm). *Pycnidia* submarginal to laminal, conspicuous, without prominent margin, frequent, ostiole black; *conidia* filiform, 8–11 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema erubescens* can be recognized by the brown reddish distinctly scrobiculate upper surface, effigurate maculae, dimorphic rhizines, brown undersurface and absence of propagules.

Hale (1965) first regarded *Parmelia erubescens* as conspecific with *P. subcaperata*. In this way he was followed by Winnem (1975), Kurokawa (1991) and Elix (1994). Krog & Swinscow (1981), however, segregated *P. erubescens* based on the absence of usnic acid (present in *P. subcaperatum*) and the presence of norlobaridone, which they found only in the African specimens. Actually, the lichen they named as *P. erubescens* could be another species, since the considerations constant in the item "Circumscription of the species" and on the Table 13 (Krog & Swinscow 1981: 156) lead to the conclusion that the specimens with salazinic acid and norlobaridone are "unnamed". Some years later, Ferraro & Elix (2000) described *Parmotrema cristobaliae* with base on this chemical combination. So the material studied by Krog & Swinscow (1981) must be revised. These authors also referred the species to Brazil although without citing the specimens examined.

Finally, Elix (1997) became convinced that *P. erubescens* and *P. subcaperata* are distinct species, based on several aspects (see Table and comments under *P. subcaperatum*).

Unfortunately, the holotype of *P. erubescens* lacks apothecia, and the specimens seen by Elix (1997) were not studied here. Nevertheless, the conidial size we found is very close to that found by him (10–14 µm) and his description also matches with the features we observed in the holotype.

The holotype is constituted by five thalli fragments glued in a paper card. Two of them, the larger ones, undoubtedly belonging to *P. erubescens*, were marked "A" in the label and are here being selected as lectotype. The three other thalli (B) belong to another species, with the upper surface grayish green, inconspicuous maculae, few cilia, the undersurface black and brown only in the narrow marginal zone, bacillar or slightly sublageniform conidia 5–6 × ca. 1 µm, and probably with stictic acid (medulla K+ yellow, C–, KC–, P+ orange).

The description of the underside is very incomplete, since the thalli are glued to the paper.

Distribution: Africa (Krog & Swinscow 1981), Oceania (Elix 1997) and in South America it was recorded to Brazil (Krog & Swinscow 1981), although without a voucher.
Elix (1997), Krog & Swinscow (1981), Swinscow & Krog (1988), Winnem (1975).

***Parmotrema eurysacum* (Hue) Hale**
Phytologia 28 (4): 336. 1974.

Parmelia eurysaca Hue, Nouvelles Archives du Muséum d'Histoire Naturelle de Paris, sér. 4 (1): 194. 1899. – Type: Mexico, 1865-1866, leg. *M. Borgeau* (holotype: P!).

(Fig. 23)

Holotype description

Thallus brownish, lobate, loosely adnate, corticicolous, 13.5 cm broad. *Lobes* irregularly branched, laterally overlapped to ± crowded in the center, 5–13 mm wide, *surface* continuous,

smooth, opaque to sublustrous, pruinose in some lobe apices; apical zone rounded; margin sinuous, undulated. *Maculae* extensive (hypermaculate). *Cilia* black, simple, up to 3.5 mm long, 0.05–0.10 mm wide, frequent. *Lacinules* simple to furcated, plane or rarely subcanaliculated, apex acute, 3–10 × 0.4–2.5 mm, undersurface black to dark brown or sometimes with brown stains. *Pustules*, *soredia* and *isidia* absent. *Medulla* white or slightly salmon (salazinic acid?). *Undersurface* black, lustrous (satin-like), smooth or sometimes slightly rugulose, with cracks; *marginal zone* brown to pale brown, lustrous, 2–5 mm wide, naked, with attenuated limit, smooth; *rhizines* black or dark brown near the marginal zone, simple to richly squarrose or irregularly branched, up to 2 mm long, 0.01–0.15 mm wide, frequent, evenly distributed, although leaving several naked areas.

Apothecia cupuliform, 4–22 mm in diameter, substipitate, margin involute, smooth to irregularly incised, amphithecium maculate, smooth or minutely scrobiculate, disc brown to dark brown, epruinose, widely perforate; *ascospores* ellipsoid, 12–15 × 7.5–9.0 µm, episporium ca. 1 µm. *Pycnidia* restricted to the lacinules, [sub]marginal or subapical, conspicuous, with prominent margin and a distinct black outline, frequent, ostiole brown; *conidia* short-filiform, 6–9 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), gyrophoric acid (minor).

Remarks: *Parmotrema eurysacum* is distinguished by the conspicuous lacinules ornate with almost marginal black outlined pycnidia, the hypermaculate upper surface, long simple cilia, and the black undersurface with a bare, brown marginal zone.

The wide lobes apparently emaculate (hypermaculate) make this species comparable with *P. latissimum*, which lacks lacinules, has larger ascospores (27–35 µm long) and sublageniform conidia. Hale (1965) compared *P eurysacum* with *P. stuppeum*, sorediate and also with sublageniform conidia. The types of *P. stuppeum* studied here, however, are almost eciliate.

One interesting feature of *P. eurysacum* is the black distinct outline around the pycnidia, which has, contrary to all species here seen, brown ostiole. These pycnidia are apparently marginal, however the ostiole open at the upper surface of the lacinules.

Fleig (1997) proposed *P. ruptum* and *P. expansum* as synonyms if *P. eurysacum*. *Parmotrema ruptum* has reticulate maculae (sometimes hypermaculate) and rare, usually simple and shorter cilia (up to 0.5 mm), while *P. expansum* (see below) presents effigurate maculae, furcated cilia and larger ascospores (16–20 .µm).

Hale & DePriest (1999) proposed *P. permaculatum* as synonym of *P. eurysacum*. Nevertheless, *P. permaculatum* lacks lacinules, has effigurate maculae, shorter cilia (up to 2 mm), and sometimes a white mottled marginal zone on the undersurface.

Based on the literature, we proposed a key and table assuming that all species inside the *“Parmotrema eurysacum* complex” are good (Spielmann 2005), which proved to be effective after the types have been studied here.

Kurokawa (2001) asserted that in *P. eurysacum* the lacinules are white in the undersurface, but this not happens with the holotype, where they are clearly black or at best dark brown or with some brown stains.

Distribution: Africa (Krog & Swinscow 1981), Oceania (Elix 1994), North America (Hale 1965, Kurokawa 2001) and South America, where it was reported for the Brazilian States of Minas Gerais (Kalb 1982, Kurokawa 2001) and Rio Grande do Sul (Fleig 1997).

***Parmotrema expansum* Hale**
Mycotaxon 5 (2): 435. 1977.

Type: Costa Rica, Province of San José, Patarrá, Desamparados, elevation 1300 m, 04-VII-1948, on rocks, 1300 m alt., 04.VII.1948, leg. *M. Guirós Calvo* 1462 (holotype: US!; isotype: UPS).

(Fig. 24)

Holotype description

Thallus stramineous, lobate, loosely adnate, saxicolous, 21 cm broad. *Lobes* irregularly branched, laterally overlapped, 4–10 mm wide, with a thin to absent black line, *surface* continuous, smooth to slightly irregular, lustrous, usually pruinose at the lobe apices, becoming cracked and sometimes rugose towards the center; apical zone rounded; margin broadly crenate to deeply incised, undulated. *Maculae* distinct to strong, effigurate, sometimes very dense and becoming hypermaculate, laminal, originating cracks. *Cilia* black, simple to furcated or sometimes cespitose, up to 1.5 mm long, 0.04–0.10 mm wide, abundant. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, shiny, smooth to slightly rugose or reticulately veined, with cracks; *marginal zone* brown or stained with dark brown or black, lustrous to shiny, 2–4 mm wide, naked, with attenuated limit, smooth, slightly rugose or papillate, sometimes veined; *rhizines* black, simple or rarely branched near the apex, up to 1.5 mm long, 0.01–0.05 mm wide, abundant, evenly distributed.

Apothecia ± plane to cupuliform, 1–7 mm in diameter, substipitate, laminal, margin smooth to dentate, lacerate on old apothecia, sometimes forming ciliate lobes, amphithecium maculate, smooth to irregular, disc brown, epruinose, imperforate; *ascospores* ellipsoid, 16–20 × 9.0–11.5 µm, episporium 1.0–1.5 µm. *Pycnidia* submarginal to laminal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* filiform, 7–12 × ca. 1 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema expansum* is recognized by the effigurate maculae, commonly furcated cilia, black undersurface and ascospores medium-sized 16–20 µm long.

It can be compared with *P. bifidum*, which also has furcated cilia, but presents somewhat darker and more ascendant lobes, a distinct black line in the lobe margins and the undersurface is pale brown.

Other species with usually branched (cespitose) cilia also have lichexanthone in the medulla, like *P. lichexanthonicum* (without vegetative propagules) and *P. spinibarbe* (sorediate).

Hale & DePriest (1999) proposed *P. expansum* as synonym of *P. ruptum*. However, *P. ruptum* is a clearly distinct species that has reticulate maculae (sometimes hypermaculate), rare, usually simple and shorter cilia (up to 0.5 mm) and shorter ascospores (10–12.5 µm).

The specimen *Marcelli* 2243, identified as *P. expansum* by Benatti (2005) was checked. It has similar cilia, but the overall morphology and color of the thallus, the shiny dark brown undersurface, the absence of effigurate maculae and the shorter conidia (6–9 µm according to Benatti 2005) makes it not identifiable as *P. expansum*. Actually, it resembles those *Parmotrema* with both salazinic acid and lichexanthone, cited above. However, TLC analysis demonstrated only atranorin, salazinic and consalazinic acid. This chemical profile, combined with the features above can represent a new taxon. Unfortunately, it is sterile, so ascospores data could not be compared.

The holotype is constituted by two parts of the same thallus. The larger part was clearly cut at the middle, and perhaps that piece was sent to UPS, where the isotype is located (Hale 1977).

Distribution: Costa Rica and Brazil, where it was recorded to the Minas Gerais State (Hale 1977).

Additional specimens examined: Brazil, São Paulo State, Municipality of São Sebastião, Centro de Biologia Marinha da USP (CEBIMAR), over rocks, 19.III.1988, leg. *M.P. Marcelli* 2243 (SP).

***Parmotrema flavescens* (Kremp.) Hale**
Phytologia 28 (4): 336. 1974.

Parmelia glaberrima var. *flavescens* Kremp., Flora 52 (14): 223. 1869. – Type: Brazil, Rio de Janeiro State, Municipality of Rio de Janeiro, leg. *Glaziou* 1833 (holotype: M!; isotype: H-NYL 35454!)

≡ *Parmelia glaberrima* f. *flavescens* (Kremp.) Kremp., Flora 59: 73. 1876.
≡ *Parmelia latissima* f. *flavescens* (Kremp.) Müll. Arg., Linnaea 43: 32. 1880.
≡ *Parmelia flavescens* (Kremp.) Nyl., Flora 68: 607. 1885.
≡ *Parmelia protoflavescens* Zahlbr., Denskschriften der Mathematsch-Naturwissenschaftlichen Klasse der Kaiserlichen Academie der Wissenschaften 83: 176. 1909. Illegitimate name based on *Parmelia glaberrima* β *flavescens* Kremp., fide Hale (1965).

= *Parmelia pseudoflavescens* Zahlbr., Denskschriften der Mathematsch-Naturwissenschaftlichen Klasse der Kaiserlichen Academie der Wissenschaften 83: 176. 1909. Nomen nudum, fide Hale (1965).

= *Parmelia mauriensis* Hue, Nouvelles Archives du Muséum d'Histoire Naturelle de Paris, ser 4 (1): 201. 1899. Type: Mexico, San Luis de Potosí, Abrededores, leg. Maury 7651 (holotype: P!).

(Fig. 25)

Holotype description

Thallus yellowish tan (herbarium), lobate, loosely adnate, probably saxicolous, 15 cm broad. *Lobes* irregularly branched, crowded, 2–10 mm wide, *surface* continuous, usually smooth and lustrous; apical zone rounded; margin crenate to broadly crenate, or isidiate, undulated. *Maculae* inconspicuous, but extensive, do not forming cracks. *Cilia* black, simple or rarely furcated at the tip, 0.3–2.0 mm, rare. *Isidia* with base concolor to the cortex, apex usually brown or sometimes concolor, simple to variously branched or coralloid, sometimes flattened, 0.1–2.0 × 0.05–0.2 mm, erect, firm, apex eciliate, mainly submarginal and marginal. *Lacinules*, *pustules* and *soredia* absent. *Medulla* white. *Undersurface* black, lustrous, smooth, slightly rugose or papillate; *marginal zone* brown to dark brown, lustrous, 1–5 mm wide, naked, with an attenuated limit, smooth to slightly rugose or papillate; *rhizines* black, simple or furcated near the apices, up to 3 mm long, 0.05–0.10 mm wide, frequent, distributed in groups.

Apothecia absent. *Pycnidia* submarginal, conspicuous, without prominent margin, few, ostiole black; conidia short-filiform, 6–9 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: usnic acid (minor), atranorin (trace), salazinic acid (major), consalazinic acid (minor), gyrophoric acid (minor).

Remarks: *Parmotrema flavescens* is characterized by the presence of usnic acid, salazinic acid and isidia, together with the presence of only monomorphic rhizines. This combination is, as far as we know, unique in *Parmotrema*. Only *P. neotropicum* also produce isidia and has usnic acid, but is differentiated by the effigurate maculae and dimorphic rhizines.

Related species with usnic and salazinic acids are *P. delicatulum* and *P. masonii* (without propagules) and the sorediate *P. mirandum*, *P. nylanderi* and *P. pectinatum*.

The holotype of *P. flavescens* (M) is a well developed thallus, although somewhat friable, and is formed by some pieces that probably were part of the same thallus. The upper surface shows a peculiar pattern of whitish stains, which could well be characterized as maculae. However, we are not sure about the nature of this "maculation", and maybe further anatomical studies could bring more information on the subject.

The isotype from H is undoubtedly part of the holotype. Together there is a part of a thallus of *Cladonia*, probably belonging to the *C. verticillaris* complex (according to Ahti & Marcelli 1995). This could indicate that the type of *P. flavescens* is saxicolous.

The holotype of *Parmelia mauriensis* is constituted by two sheets, one with only one large thallus, and another with two thalli glued in a paper. The first was at some time already glued, as one can see looking at the undersurface, and it has a label from Hale dated 1962, indicating it as holotype. It is a large thallus, with more cilia and abundant isidia. Apart from this it agrees well with *P. flavescens*, including the conidia type and size. The second sheet contains two thalli that are possibly part of the same collection, since the features are very similar.

Hale (1960) placed *Parmelia microdactyla* in the synonymy of *P. delicatula* and compared it with *P. flavescens*, the difference being the production of lobules instead of isidia. In fact, rare flattened isidia can be seen in the holotype of *P. flavescens*. But the total absence of isidia, together with a paler thallus can set *P. microdactyla* closer to *P. magna*.

Distribution: Africa (Müller Argoviensis 1880), Central America (Hue 1899, Hale 1965, Tenorio *et al.* 2002) and South America (Hale 1965). In South America it is known to Brazil, where it was recorded to the States of Minas Gerais (Ribeiro 1998), Mato Grosso do Sul (Fleig & Riquelme 1991), Paraná (Eliasaro 2001, Donha 2005), Rio de Janeiro (Krempelhuber 1869, 1876a; Nylander 1885; Hale 1965), Rio Grande do Sul (Fleig 1997) and São Paulo (Zahlbruckner 1909, Ribeiro 1998, Benatti 2005).

Parmotrema foliolosum **(C.W. Dodge) Spielmann & Marcelli, comb. nov.**

Parmelia foliolosa C.W. Dodge, Annals of the Missouri Botanical Garden 46 (1-2): 89. 1959. – Type: Madagascar, East Imerina, Andrangolóaka [Dodge 1959 wrote "Andrangolaoka"], terricolous, XI.1880, leg. *J.M. Hildebrandt* (Comm. C. Rensch.), (holotype: FH!).

(Figs. 26-27)

Holotype description

Thallus grayish, lobate, loosely adnate, terricolous, formed by several pieces (according with the protologue reaching up to 6 cm). *Lobes* irregularly branched, laterally overlapped, 1–6 mm wide, *surface* continuous, reticulate, sometimes cracked, smooth, and opaque, remaining continuous or

becoming rugose in the older parts; apical zone rounded, often concave; margin usually crenate, sometimes sublacinulate, undulated. *Maculae* reticular, laminal, sometimes extensive (hypermaculate), originating cracks. *Cilia* black, simple or rarely furcated, up to 0.5 mm long (usually shorter), abundant. *Soralia* usually in shapeless extensive formations, sometimes orbicular, often submarginal and turning the lobes involute; *soredia* farinose. *Isidia*, *pustules* and *lacinules* absent. *Medulla* white. *Undersurface* black, lustrous, smooth or papillate, with few cracks; *marginal zone* dark brown, lustrous, 1–2 mm wide, naked or rarely rhizinate, with a attenuated limit, smooth or papillate; *rhizines* black, usually simple, sometimes thickened (as in *Canomaculina*) and branched, rarely squarrose, up to 1 mm long, abundant, more or less evenly distributed.

Apothecia absent. *Pycnidia* usually submarginal, conspicuous, without prominent margin, frequent, ostiole black; *conidia* filiform, (7–) 15–26 (–30) × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), protocetraric acid (trace).

Remarks: *Parmotrema foliolosum* can be recognized by the hypermaculate upper surface, short cilia (up to 0.5 mm), long conidia (up to 30 µm), black marginal zone in the upper surface, and a brown nude marginal zone in the undersurface (Fig. 27). There's also thickened and branched rhizines, resembling that of the former genus *Canomaculina* sensu Elix (1997).

This species was placed as synonym of *P. reticulatum*, which has only reticular maculae (never hypermaculate) and shorter conidia (up to 12 µm).

Parmotrema foliolosum has the longest conidia of the genus, followed by those of *P. austrocetratum* (up to 25 µm) and *P. arteagum* (up to 23 µm, fide Egan 1982).

Distribution: Africa (Dodge 1959).

***Parmotrema granulare* (Asahina) Spielmann & Marcelli, comb. et stat. nov.**

Parmelia cetrata Ach. f. *granularis* Asahina, The Journal of Japanese Botany 16: 593. 1940. – Type: Formosa (Taiwan), Prov. Taichu, Keitau, 24.XII.1933, leg. *Y. Asahina* 33125 (holotype: TNS!).

(Fig. 28)

Holotype description

Thallus brownish in herbarium, lobate, loosely adnate, corticicolous, 23 × 16 cm broad. *Lobes* more or less radial, irregularly branched, contiguous, 4–11 mm wide, *surface* continuous, smooth, lustrous, becoming rugose and reticulated cracked in the center; apical zone rounded; margin broadly crenate, undulate or lacinulate. *Lacinules* canaliculated, corniculate contorted, subdichotomous to subpalmate, localized in the whole thallus, but much more abundant in the centre, apex usually acute, sometimes rounded, 1–12 × 0.4–2.0 mm. *Maculae* distinct, reticular, laminal, originating cracks. *Cilia* black, simple to squarrose, (0.1–) 1.0–2.5 × 0.02–0.05 mm, abundant. *Pustules* rugose to vesiculate, situated almost exclusively in the lacinules, giving rise to soralia. *Soralia* pustular; *soredia* granular. *Isidia* absent. *Medulla* white. *Undersurface* black, lustrous, papillate, with numerous scars in the centre; *marginal zone* brown, lustrous, 1–4 mm

wide, naked, with an attenuated limit, papillate or with scarce rhizines, rarely veined; *rhizines* black, simple or squarrose, (0.2–) 0.5–3.0 × 0.02–0.06 mm, abundant, irregularly distributed.

Apothecia unknown. *Pycnidia* in the lacinules, laminal or subapical, conspicuous, with or without prominent margin, few, ostiole black; *conidia* filiform, 7.5–13.0 × ca. 0.5 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin and salazinic acid.

Remarks: *Parmotrema granulare* is distinguished by the vesicular and rugose pustules along the lacinules, the reticular maculae, the ciliate margin and the presence of salazinic acid. The thallus is relatively large (23 × 16 cm), with wide lobes (4–11 mm).

This species was first described as *Parmelia cetrata* f. *granularis* (Asahina 1940). Afterwards, Asahina (1952) placed it as a synonym of *Parmelia cetrata* f. *subisidiosa* Müll. Arg. Apparently it was studied only by Asahina himself, and fortunately Hale & Fletcher (1990) listed it as synonym of *P. reticulatum*.

However, *P. reticulatum* is a not pustulate species whose soralia is extensively submarginal or situated in short lacinules (0.5–2.2 mm), has a smaller thallus 6.5–7.0 cm large, present crowded lobes and shorter cilia (0.1–1.0 mm).

The holotype of *P. granulare* is well developed, with the necessary features to characterize the species, except the apothecia. Fertile specimens, from the type locality (Taiwan) or close locations could bring more data about this taxon, known only by the holotype.

The presence of the numerous vesicular pustules probably lead Asahina (1940) to propose the epithet “granularis”.

Distribution: Taiwan (Asahina 1940, 1952).

Parmotrema herrei **(Zahlbr.) Spielmann & Marcelli, comb. nov.**

Parmelia herrei Zahlbr., in Herre, Proceedings of the Washington Academy of Sciences 7: 353. 1906. – Type: U.S.A., California, Santa Cruz Peninsula, Pilarcitos Canyon, two miles from sea, elevation 200 feet, May 28, 1904, leg. *A.W.C.T. Herre* 516 (lectotype: FH!; duplicates of the lectotype: FH!, W!).

(Fig. 29)

Lectotype description

Thallus beige (herbarium), laciniate, adnate, growing “on earth in the crevices of sandstone”, up to 7 cm broad; *laciniae* usually plane, less frequently undulate and with concavities, or subcanaliculate, dichotomous, crowded, 1–3 mm wide; *surface* continuous, smooth, lustrous, becoming cracked in the older parts; apex usually acute, sometimes truncate or slightly rounded; margin smooth or sublacinulate. *Maculae* distinct, reticular, laminal. *Cilia* black, usually branched (irregular, subdichotomous to subpalmate), rarely squarrose, up to 3 mm long, thickened, contiguous. *Pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, rugose, with a few cracks; *marginal zone* absent or dark brown, lustrous, up to 3 mm wide, naked, rhizinate or papillate; rhizines black, simple or less frequently branched, up to 2 mm long, thinner than cilia, frequent, evenly distributed.

Apothecia unknown. *Pycnidia* laminal, more abundant in the apical zones, conspicuous, without prominent margin, abundant, ostiole black; conidia unknown (ca. 30 pycnidia analyzed).

Color reactions: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor), protocetraric acid (trace).

Remarks: *Parmotrema herrei* can be recognized by the long (up to 3 mm), thickened and branched cilia, and the strictly laciniate thallus.

It is close to *Parmotrema cetratum*, and was up to know situated as its synonym (Hale & Fletcher 1990). Nevertheless, typical *P. cetratum* (lectotype: H-ACH; duplicate of the lectotype: UPS) has a wider laciniae (2–5 mm) and shorter cilia (up to 1.3), just simple to furcated.

Although lectotype, duplicates of the lectotype and "topotypes" are plenty of pycnidia, no conidia could be found (numerous pycnidia examined). Maybe future collections of fresh material could contribute with this information. Contact with North American lichenologists (especially the Californian Lichen Society) looking for additional specimens unfortunately did not returned results. Probably this is an endangered species, although originally mentioned as common in the type locality (Herre 1910).

The lectotype (FH) is small although representative. It is growing with the sorediate *Parmotrema reticulatum* and another *Parmeliaceae*. Both isotype and the "topotype" (FH) are well developed and also identical to the holotype in every detail.

As far as we know, the only collector of *P. herrei* was Albert W. C. T. Herre, and this species is known just to the type locality. Wiggins (1962) described the collection method of Herre: "*On the field trips he rode a bicycle with an old suitcase strapped to the rack and loaded his specimens into it. He explored nearly every road, trail, canyon and mountainside on the whole Santa Cruz Peninsula.*" Apparently the first Herre's collection of *P. herrei* was made in May 28, 1904 (lectotype in FH, duplicate of the lectotype in W). Then, again in June 30, 1906 ("topotype", No. 825, FH), and in May 22, 1942 (specimen from the Herbarium Herre in F!).

The typification of this species is a little obscure. Zahlbruckner *in* Herre (1906) asserted that specimens were "*in the herbaria of Leland Stanford Junior University, Dr. A. Zahlbruckner, Dr. H.E. Hasse, and the author…Type, No. 516*". Berry (1941) stated that the type was in US, collected in May 28, 1904, and listed also several Herre specimens made in June 30, 1906, deposited in MBG, F, MIN, LSU and Hale & Fletcher (1990) chose one specimen deposited in FH as the lectotype, and from W and US as "isolectotypes".

Actually, in 1963 Hale annotated "holotype" in the FH specimen, a collection that clearly belonged to the "Herb. Hasse". Also in 1963, Hale labeled a specimen in FH (No. 516) as isotype and the No. 825 as "topotype". The specimen in W was labeled as "holotype". There is also a specimen in US whose packet was annotated by Hale as "topotype (compared with the holotype)", A.C. Herre 825, June 30, 1906 [it seems to be part of the No. 825 deposited in FH].

We don't know if the Herbarium of Stanford University hold specimens of *P. herrei*, especially the specimen cited in the protologue (Herre 1906). If positive, it can be selected as the type. On the other hand, Herre (1942) asserted that the collections seen by Berry (1941) were from his personal herbarium, not from the herbarium of Stanford University. So the typification of this species deserves future work, and in the moment we are using, in part, the choices made by Hale & Fletcher (1990).

The only author besides Herre to mention this species was Berry (1941). In this rarely cited paper, *P. herrei* was reported as having a K– medulla. In the Field Museum (F) there is a specimen determined by E.C. Berry, on March 4th, 1940. It is, actually, a *Parmotrema* with ciliate isidia, the medulla K+ yellow (stictic acid), perhaps *P. crinitum* (Ach.) Choisy.

Distribution: Known only from the type locality (Herre 1906, 1910; Berry 1941).

Additional specimens examined: U.S.A: California, Pilarcitos Creek, Santa Cruz Mountains, earth & sandstone, 200–300 feet, June 30, 1906, leg. *A.C. Herre* 825 (FH, US). Idem, Pilarcitos Creek, Idem, Pilarcitos Creek Cañon, San Mateo County, on sandstone, elev. 400–500 feet, May 22, 1942, leg. *A.C. Herre* (F).

Parmotrema lacteum **Marcelli & Spielmann**
Bibliotheca Lichenologica 96: 215. 2007.

Type: Brazil, Rio Grande do Sul State, Municipality of Boqueirão do Leão, Cascata do Gamelão, saxicolous, on the rocky wall downstream from the cascades, inside the forest (shady), 29°18'13.7"S, 52°26'51.7"W, 500 m alt.., 01.II. 2004, leg. *A.A. Spielmann* & *M.A. Sulzbacher* 1307 (holotype: SP!).

(Fig. 30)

Holotype description

Thallus saxicolous, milky pale gray, lobate, membranaceous, loosely adnate, 7.5–11.5 cm broad; *lobes* irregularly branched, laterally overlapping, 2.5–7.0 mm wide, plane to concave, with extended median axis and rounded apices; *margin* subundulate, often ascending, crenate to sublacinulate; lateral margin plane to ascending, lacinulate; *distal surface* smooth to slightly scrobiculate, opaque, reticulate-maculate, becoming cracked in the center; *lacinulae* marginal, simple, furcated or irregularly branched, 0.2–2.5 × 0.2–2.0 mm, plane to canaliculated, with a rounded or acute apex, present over the entire thallus; *maculae* distinct, reticulate, laminal, developing into cracks; *cilia* black, simple to commonly subsquarrose, 0.20–2.00 × 0.02–0.05 mm, frequent, evenly distributed. *Pustules* absent. *Soredia* granular, produced mostly from subapical bulges of the lacinulae; true *isidia* absent; however, the soredia may pile up forming structures (isidioid soredia) which are ecorticate, terete, not ramified, with brown ciliate apex, 0.10–0.50 × 0.02–0.10 mm (including the cilia), often marginal, sometimes submarginal and reaching the lamina, rarely laminal, generally forming capitate sorediose clusters on the lacinulae. *Medulla* mostly white, but with an orange, K – pigment at the isidia clusters. *Lower surface* black, shiny, smooth to slightly rugose; *marginal zone* dark brown or sometimes beige, 1–2 mm wide, shiny, nude, rhizinate or papillate-rhizinate, with attenuate borders, smooth to slightly rugose; *rhizinae* black, simple to squarrose or irregularly branched, 0.10–3.00 × 0.02–0.05 mm, abundant, evenly distributed.

Apothecia and *pycnidia* unknown.

Color reactions: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C: atranorin, salazinic acid and consalazinic acid, unknown pigment.

Remarks: *Parmotrema lacteum* is recognized by the milk-white thallus coloration, the commonly subsquarrose cilia, the capitate sorediose clusters originating isidioid soredia, the orange pigment in the apices of the lacinulae, and the presence of salazinic and consalazinic acids.

Parmotrema subisidiosum (Müll. Arg.) Hale (holotype: G) is distinguished by the shorter, simple cilia (up to 0.6 mm), and the formation of marginal to laminal, simple to coralloid true isidia, 0.1–0.2 × 0.05–0.15 mm, that remain entire or can form granules, but not soredia. *Parmotrema bonplandii* (Mata) Blanco, Crespo, Divakar, Elix & Lumbsch, produces

norlobaridone and lichexanthone in the medulla (Mata García 1994). Finally, *P. clavuliferum* is somewhat similar in forming soredia on the lacinulae, but never produces isidioid structures.

This species has now the distribution extended to São Paulo State.

Distribution: Brazil, Rio Grande do Sul State (Marcelli *et al.* 2007) and São Paulo State (here reported).

Additional specimens examined: Brazil, Rio Grande do Sul State, Municipality of Boqueirão do Leão, Cascata do Gamelão, saxicolous on the rocky wall downstream from the cascades, inside the forest (shady), 29°18'13.7"S 52°26'51.7"W, 500 m alt., 01.II.2004, leg. *A.A. Spielmann & M.A. Sulzbacher* 748, 751 (SP). São Paulo State, Municipality of São Luís do Paraitinga, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, near the director's house, 23°19′43,0″S, 45°08′26,3″W, 915 m alt., corticicolous, field with forest in the surroundings, exposed, 14.I.2007, leg. *A.A. Spielmann*, *P. Jungbluth*, *L.S. Canêz* & *M.J. Kitaura* 3362 (SP). Idem, at Trilha da Pirapitinga, 23°20′17,2″S, 45°08′45,8″W, 915 m alt., corticicolous, forest border, exposed, 14.I.2007, leg. *A.A. Spielmann*, *P. Jungbluth*, *L.S. Canêz* & *M.J. Kitaura* 3343 (SP).

Parmotrema latissimum (Fée) Hale
Phytologia 28 (4): 337. 1974.

Parmelia latissima Fée, Ess. Crypt., Suppl.: 119, pl. 38, fig. 4. 1837. – Type: Jamaica, s.c. (lectotype: G!; duplicate of the lectotype: G!, Herbier Müller Arg.).

(Fig. 31)

Lectotype description

Thallus brownish, lobate, loosely adnate, 12.5 cm broad. *Lobes* irregularly branched, laterally overlapped, very large, 6–25 mm wide, *surface* continuous, smooth, lustrous, becoming slightly rugose and irregularly cracked in the center; apical zone rounded; margin smooth, undulated, occasionally with some adventitious lobules. *Maculae* absent. *Cilia* absent. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* impossible to describe since the thallus is totally glued to a card, but the large nude marginal zone is visible.

Apothecia concave to cupuliform, up to 15 mm in diameter, substipitate, laminal or submarginal, margin incised to lacerate, often involute, amphithecium maculate, rugose to irregularly areolate-cracked, disc dark brown, epruinose, imperforate or perforate in one apothecium; *ascospores* ellipsoid, large, 27–35 × 15–17 µm, episporium 2–3 µm. *Pycnidia* submarginal or less commonly laminal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* sublageniform, 6–8 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema latissimum* can be recognized by the wide lobes, sublageniform conidia and absence of cilia and propagules.

The general morphology, conidia and ascospores are similar to that of *P. cristiferum*. This supports the idea they constitute a species pair, as already asserted by Hale (1965).

Parmotrema mantiqueirense also has wide lobes and lack propagules, but develops conspicuous cilia and has filiform conidia.

The lectotype of *P. latissimum* is totally glued to a paper card, so the underside could not be described. The typification of this species also requires some comments. From the three specimens we received upon request, two have Hale's annotations: 1) the specimen from "Jamaica insula" (G00053795), with the label information about his publication and which exactly correspond to the plate published by Fée (1837), was annotated as "isotype" [actually the lectotype] by Hale in 1962; 2) the specimen growing "ad ramos cinchonarum" (G00053796), was annotated as "*Parmelia zollingeri* Hepp" by Hale in 1962.

In our opinion, the specimen G00053975 is the lectotype of *Parmelia latissima*, designated by Hale, since it has the Hale's handwriting and exactly the same data cited by him in his monograph (Hale 1965).

The specimen G00053796 is actually composed by three glued thalli in a card. The thallus at the right of the card we labeled "A": it has a well developed, imperforate apothecium, sublageniform conidia, 6–8 × ca. 1 µm, ascospores ellipsoid, 27–33 × 13.0–16.5 µm, episporium 2–3 µm. The upper cortex contains probably atranorin (K+ yellow) and the medulla is K+ brownish, C–, KC– and P+ yellow → quickly orange (protocetraric acid?). The thallus at the left of the card (labeled "B") has also sublageniform conidia (6–8 × ca. 1 µm) and the same reactions as the "A" thallus. In 1962, Hale labeled this specimen as *Parmelia zollingeri*. However, future studies are necessary since the list of synonyms of this species is long, and Hale (1965) apparently employed a wide species concept, accepting both specimens ciliate and eciliate as belonging to the same taxa (see also Elix 1998).

Finally, the thallus at the middle of the card ("C") is an isidiate lichen with the upper cortex K+ yellow (atranorin) and the medulla K–, C+ red, KC+ red and P– (lecanoric acid), clearly belonging to *Parmotrema tinctorum* or some close species.

The third specimen (G00053794) sent to us has a label from Müller Argoviensis (dated 1896) indicating the published data from Fée (1837) and another from R.v. Aubel (dated 22.II.1985) indicating that this is the lectotype, according to Hale (1965). But there are no Hale's annotations with this specimen and we believe that Hale really never saw it. It is identical morphologically (including the sublageniform conidia) and chemically with the specimen G00053975, and so this specimen (G00053794) can be named as "duplicate of the lectotype".

Distribution: Asia (Hale 1965, Divakar & Upreti 2005), North, Central and South America (Hale 1965). In South America it was reported to Brazil, Colombia, Peru, Venezuela, Hale (1965). In Brazil it was recorded to the States of Mato Grosso (Hale 1965) and Mato Grosso do Sul (Fleig & Riquelme 1991).

***Parmotrema leucosemothetum* (Hue) Hale**
Phytologia 28 (4): 337.

Parmelia leucosemotheta Hue, Nouvelles Archives du Muséum d'Histoire Naturelle de Paris, sér. 4 (1): 192. 1899. – Type: Mexico, surroundings of San Luis Potosí, December 1886, leg. *P. Maury* 7650 (holotype: P!).

≡ *Canomaculina leucosemotheta* (Hue) Elix, Mycotaxon 65: 477. 1997.

(Figs. 32-34)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, 13–15 cm broad. *Lobes* irregularly branched, laterally overlapped, 6–17 mm wide, *surface* continuous or irregularly cracked, smooth, with some irregular depressions, lustrous, becoming rugose and reticulately cracked towards the center; apical zone rounded; margin broadly crenate-incised or sublacinulate, undulated. *Maculae* strong, effigurate, laminal, originating cracks. *Cilia* black, simple and usually thickened and ± tapered, up to 2.5 (–3.0) mm long, 0.04–0.10 mm wide, abundant. *Soralia* whitish, marginal or in the apex of the sublacinules, linear interrupted; *soredia* farinose to subgranular. *Lacinules*, *pustules* and *isidia* absent. *Medulla* white. *Undersurface* dark brown to blackish in some central areas, shiny, smooth to rugose and scrobiculate, also with some veins, with cracks; *marginal zone* absent or usually dark brown and shiny, naked; *rhizines* black or concolor to the undersurface, monomorphic, up to 2 mm long, usually thickened, 0.02–0.20 mm wide, simple or irregularly branched, especially near the apices, abundant, distributed in groups.

Apothecia absent [according to Hale (1965), apothecia rare, ± adnate, to 6 mm in diameter, amphithecium sorediate, disc imperforate or rarely perforate; ascospores 12–16 × 7–10 µm]. *Pycnidia* submarginal to laminal, conspicuous, usually without prominent margin, frequent, ostiole black; *conidia* filiform, 8–12 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema leucosemothetum* is characterized by the soralia almost exclusively marginal, the strongly maculate upper cortex (Fig. 33), the simple, usually thickened and ± tapered cilia, and the distinct bare marginal zone on the undersurface (Fig. 34).

It has been constantly confused with *P. subsumptum*, which have the marginal soralia growing backwards on the undersurface, scarce cilia (if present) and weak maculae.

Parmotrema petropoliense, another near species, has slender bifurcate cilia.

An interesting feature to note is that in *P. leucosemothetum* holotype the thickened rhizines are much more common than the slender ones. Usually in this group (formerly *Rimeliella*) the contrary is the rule.

Krog & Swinscow (1981) reduced *P. leucosemothetum* to synonymy of *P. subsumptum*, with base on the variation they found in African species. Fleig (1997) accepted this synonym. However, these authors do not discuss some important features to distinguish these two species, namely the cilia and the maculation. Based on the types here studied, they are clearly distinct taxa, and the specimens identified by these authors should be revisited to clarify their identity.

Also the record from Vareschi (1962) to Venezuela need to be checked, since judging by the published picture it seems to have reticular maculae and capitate soralia growing in lacinules, typical of the species formerly placed under *Rimelia*.

The holotype collection is constituted by two larger well-preserved thalli and one smaller (5 cm broad), not as characteristic as the others. Apothecia are absent. Hale (1965) gave a description of apothecia he found probably in some additional specimen examined (see above in the description).

Distribution: Africa (Winnem 1975, Hale 1965, Krog & Swinscow 1981) Asia (Kurokawa & Lai 2001) and Americas (Hue 1899, Hale 1965, Nash & Elix 2002a). In South America, it is known to Argentina, Brazil (Hale 1965) and Venezuela (Vareschi 1962, 1973). In Brazil, it was recorded to the States of Minas Gerais (Hale 1965), Paraná (Osorio 1977b), Rio Grande do Sul (Canêz 2005) and São Paulo (Hale 1965).

***Parmotrema lichexanthonicum* Eliasaro & Adler**
Mycotaxon 63: 49. 1997.

Type: Brazil, Minas Gerais State, Municipality of Santana do Riacho, Serra do Cipó, Alto Palácio, 19°22′S, 43°32′W, saxicolous, in "campo rupestre", 01.II.1989, leg. *S. Eliasaro* 807 (holotype: UPCB-24699!; isotypes: BAFC-37875! and CANB).

(Fig. 35)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, saxicolous, 13 cm broad. *Lobes* irregularly branched, somewhat crowded, 5–15 mm wide, *surface* continuous or inconspicuously reticulate-cracked in some lobes, usually smooth, lustrous to opaque, becoming slightly cracked in the older lobes; apical zone more or less rounded to irregular; margin broadly crenate, sinuous, undulated. *Maculae* weak, effigurate or assuming a pseudo-reticular pattern, more visible in the amphithecia. *Cilia* black, simple or more usually cespitose, short 0.2–0.6 (–1.0) × 0.01–0.05 mm, frequent, friable (sparse for almost all upper surface). *Lacinules*, *pustules*, *isidia* and *soredia* absent. *Medulla* white. *Undersurface* black, lustrous, strongly papillate, with cracks, rarely veined; *marginal zone* absent to black or dark brown, lustrous, 1–3 mm wide, naked, with an attenuated limit, smooth or papillate; *rhizines* black, simple or rarely furcated, although sometimes difficult to ascertaining since usually the rhizines are glued in tufts by their apices, frequently short, 0.1–0.6 (–1.0) × 0.01–0.04 mm, very abundant, evenly distributed.

Apothecia cupuliform, 1–10 mm in diameter, stipitate, submarginal to laminal, margin smooth or sometimes deeply dentate, amphithecium maculate, rugose, disc dark brown, epruinose, perforate; *ascospores* slightly ovoid to ellipsoid, 14–16.5 × 6.5–7.5 µm, episporium ca. 1 µm. *Pycnidia* laminal to more usually submarginal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* short-filiform, 6.5–9.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV+ yellow.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), lichexanthone (minor).

Remarks: *Parmotrema lichexanthonicum* is characterized by the presence cespitose cilia, medulla with lichexanthone and salazinic acid, and the absence of vegetative propagules.

The presence of cespitose cilia in this species is notorious and was already pointed out by Ribeiro (1998). It is correlated with the presence of lichexanthone in the medulla. Similar species with salazinic acid and lichexanthone include *P. pontagrossense* and *P. spinibarbe* (sorediate), and *P. ultralucens* (isidiate).

While identifying specimens of *Parmotrema lichexanthonicum*, we realized that the medulla not always shows an evident yellow bright under the UV lamp. Donha (2005) noticed the same for *P. pontagrossense* and suggested the TLC analysis as essential to assure the presence of lichexanthone. However, the experience has demonstrated that the presence of cespitose cilia together the typical dark reddish brown shiny marginal zone are strong indication of the medullar lichexanthone presence in *Parmotrema* species.

Both the holotype and isotype are well developed thalli, and the isotype (BAFC) agrees well with the holotype in all features. Indeed, the faint maculate upper surface is more easily seen in this thallus.

An important and relatively recent problem is the exploration of Brazilian lichens in a commercial scale. Christensen & Sipman (1998) noted that Brazilian lichens were sold in European markets. They thought that one of the species was *Parmotrema cetratum* (Ach.) Hale.

However, close examination of the specimens deposited in C proved they are actually *Parmotrema lichexanthonicum*. So, it is possible that this apparently endemic lichen be an endangered species.

Distribution: known to Brazil, where it was recorded to the States of Minas Gerais (Eliasaro & Adler 1997, Ribeiro 1998) and São Paulo (Ribeiro 1998).

***Parmotrema livido-tesselatum* (Hue) Spielmann & Marcelli, comb. nov.**

Parmelia livido-tesselata Hue, Nouvelles Archives du Muséum d'Histoire Naturelle de Paris, sér. 4 (1): 191, plate V, fig. 2. – Type: Uruguay, Montevideo, Cerro Melones, saxicolous, June 18, 1876, leg. *Fruchart* s.n. (lectotype: P!; isotypes: TUR!).

(Fig. 36)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, saxicolous and over mosses, up to 27 cm broad (combining the parts). *Lobes* irregularly branched, somewhat crowded, growing in multiple directions (i.e., not radial), 5–15 mm wide, *surface* continuous to reticulate-cracked, opaque to lustrous, strongly maculate, pruinose in some lobe apices; apical zone rounded; margin sublacinulate, with well marked incisions. *Maculae* strong, reticular, sometimes extensive (hypermaculate), originating cracks. *Cilia* black, simple to furcated, rarely more branched, sometimes thickened, 1.0–3.5 × 0.05–0.20 mm, abundant. *Soredia* farinose, initially coming from the margins of the areolae, coalescing with the age and forming plane or extensive, laminal or more commonly submarginal soralia, sometimes with a pustular appearance. *Lacinules* simple, projected from the margin of the lobes, plane, apex rounded/to ± truncate, up to 5 mm long, 0.5–2.0 mm wide. *Isidia* absent. *Medulla* white. *Undersurface* black, lustrous, usually papillate, less commonly smooth or rugose, with cracks*; marginal zone* dark brown, lustrous, 1.5–4.0 mm wide, naked, with an attenuated limit, usually smooth, rarely slightly papillate; *rhizines* black, simple or sometimes squarrose or furcated, 0.2–2.5 × 0.02–0.10 mm, abundant, irregularly distributed.

Apothecia concave, 5–6 mm in diameter, substipitate, laminal, margin incised (difficult to define since the apothecia are not in good conditions), amphithecium scrobiculate, disc brown, epruinose, apparently perforate; *ascospores* ellipsoid 13 × 6.5–7.5 µm, episporium ca. 1 µm (see the notes below). *Pycnidia* not found (several black structures investigated, but without conidia).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC (J.A. Elix, 25.II.1996, label with the isotype): atranorin (major), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema livido-tesselatum* has a wide and distinct bare zone on the underside, thickened, tortuous, tapered and usually furcated cilia, an upper surface strongly maculate, and the soralia often laminal and eruptive rose from the thallus cracks.

Hale & Fletcher (1990) situated this species as synonym of *Rimelia reticulata*. Actually, this lichen is more close to *Parmotrema austromaculatum*, differing by the presence of soredia. It is also interesting to note that, in *P. livido-tesselatum*, the sorediate lobes do not become involute, as commonly happen to other “rimelioid” species.

The holotype collection (PC) is composed of four thalli, or possibly parts of just one thallus, since Hue's (1899) thallus measure is 27 cm broad, which agree with our observation. One of the parts contains two smashed apothecia, and is glued to a paper with the annotation "n. 33". Apparently Hue saw just one apothecia, the more developed, and we chose the second one to take the ascospores measures, as to preserve the main apothecium. The hymenium is not well developed, and just two ascospores were found. They are 13 × 6.5–7.5, so matching the variation described in the protologue (12–16 × 7–8 µm).

There are two lichens preserved in TUR, numbered "02620" and "02621", which were part of the Herbarium Vainio. They are very similar in every feature with the lectotype from PC, and the labels are indicating "isotype". In fact, it seems clearly that they are parts of the collection from PC. However, Hue's (1899) original publication cited two collections: one from Uruguay and another from "Africa meridionalis". Probably this information led Hale & Fletcher (1990) to choose the specimen from PC as lectotype, and the specimen from TUR (probably only the n. 02620, since it is the only one with Hale annotations) as "isolectotype". This term is not used by the current ICBN (*Vienna Code*), and so it can be called "duplicate of the lectotype".

The specimen referred by Hue (1899) to South Africa requires to be revised, since it can indicate an interesting distribution pattern.

Distribution: Uruguay and South Africa (Hue 1899, Zahlbruckner 1930a).

Parmotrema magnum **(Lynge) Spielmann & Marcelli, comb. nov.**

Parmelia magna Lynge, Arkiv för Botanik 13 (13): 83. 1914. – Type: Brazil, Minas Gerais State, Municipality of São João d'el Rey [del Rei], 31.VIII.1892, leg. *G.O.A. Malme* 269 (holotype: S!; isotypes: LD!, MO, UPS!).

= *Parmelia microdactyla* Hale, Contributions from the United States National Herbarium 36 (1): 21. 1960. – Type: Brazil, [Rio de Janeiro State], Municipality of Rio de Janeiro, "På översta toppen av Corcovado" [at the very top of the Corcovado mountain], leg. *Fr. Widgren* (holotype: UPS!; isotype: S!).

(Figs. 37-40)

Holotype description

Thallus yellowish, lobate, loosely adnate, probably saxicolous, 17 cm broad. *Lobes* irregularly branched, laterally overlapped to crowded, 5–15 mm wide, *surface* continuous, smooth, sublustrous, becoming slightly rugose towards the center; apical zone rounded; margin crenate to sinuous, undulated. *Maculae* absent. *Cilia* black, simple or furcated, up to 1.5 mm long, 0.05–0.10 mm wide, few. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, sublustrous, smooth to rugulose, papillate near the margins, or rarely with veins, with cracks; *marginal zone* dark brown, lustrous, 1.0–3.5 mm wide, naked, with an attenuated limit, smooth or rugulose; *rhizines* black, simple or rarely irregularly branched, delicate, up to 2.5 mm long, 0.02–0.06 mm wide, abundant, distributed in groups.

Apothecia flattened or cupuliform, usually lacerate and with the margins involute, up to 10 mm in diameter, short stipitate, submarginal, margin smooth or incise, amphithecium maculate, rugose or scrobiculate at maturity, disc brown, epruinose, imperforate; *ascospores* ellipsoid, 10.0–12.5 × 7.5–8.0 µm, episporium ca. 1 µm. *Pycnidia* submarginal, conspicuous, with or without prominent margin, frequent, ostiole black; *conidia* short-filiform, 6.0–7.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C+ rose, KC+ red, P+ strong yellow, UV–.

TLC in solvent C, HPLC (J.A. Elix, 10.V.1996, label with the holotype in S): usnic acid (minor), salazinic acid (major), consalazinic acid (minor), gyrophoric acid (major), lecanoric acid (trace).

Remarks: *Parmotrema magnum* can be recognized by the yellowish large thallus (up to 17 cm) and wide lobes (5–15 mm), with not abundant cilia up to 1.5 mm long. The apothecia are usually lacerate, with a rugose to scrobiculate amphithecia (Fig. 38). The medulla reacts C+ rose, KC+ red, an indicative of the abundance of gyrophoric acid.

It is close to *P. delicatulum*, from which it was already considered a synonym (Hale 1965). However, *P. delicatulum* has a smaller sublaciniate thallus with narrow lobes (1.0–3.5 mm), cilia abundant, simple and longer (up to 2.8 mm), and smooth entire amphithecia. Although the gyrophoric acid was reported to this species (see above), it is not abundant enough to cause a positive spot test, and so the medulla is C–, KC–.

These differences are being considered here as important to maintain these taxa as good species. Future studies with additional specimens from a wider area can corroborate or not this positioning.

A special problem occurs with *Parmelia microdactyla* Hale. This species was proposed (Hale 1960) based on the presence of marginal lobules and very sparse cilia. Later on, Hale (1965) assumed this difference as a morphological variation, and situated *P. microdactyla* as a synonym of *P. delicatula* (together with *P. magna*). The holotype is represented by a well-preserved thallus 8.5 cm broad (Fig. 39), with pruinose lobes (at the apices), abundant lobules (Fig. 40) and rare, short cilia (up to 0.5 mm long). It is also very close to *Parmotrema flavescens*, whose isotype (S) was found growing together. However, no sign of isidia was found. The chemistry of the isotype was made through TLC in solvent C and HPLC (J.A. Elix, 10.V.1996), and revealed usnic acid (minor), salazinic acid (major), consalazinic acid (minor), gyrophoric acid (major), lecanoric acid (trace). The medulla of this specimen is C–, KC+ rose, and so intermediary between *P. delicatula* and *P. magna*.

Unfortunately, apothecia are unknown both in *Parmotrema microdactyla* and *P. flavescens*, and so additional differences or similarities could not be compared. By the moment, we place *P. microdactyla* under *P. magnum* because the almost absence of cilia.

Distribution: known for Brazil, being recorded to the States of Minas Gerais (Lynge 1914, Hale 1960) and Rio de Janeiro (Hale 1960).

***Parmotrema mantiqueirense* Hale**

Bibliotheca Lichenologica 38: 113. 1990.

Type: Brazil, Minas Gerais State, Serra da Mantiqueira, Oberhalb von Vila Monte Verde, zwischen 1880 m und der Gipfelregion des Pedra Redonda in 2000 m, 3.VII.1979, leg. *K. Kalb* s.n. (holotype: Kalb herbarium; isotype: US!).

(Fig. 41)

Isotype description

Thallus whitish gray, lobate, loosely adnate, over rocks with mosses and plant debris, 11.5 cm broad. *Lobes* irregularly branched, laterally overlapped to quite crowded, 7–20 mm wide, *surface* continuous, smooth, lustrous, becoming irregularly scared and cracked towards the center; apical zone ± rounded; margin broadly crenate to sublacinulate, undulated. *Maculae* absent. *Cilia*

black, simple to furcated, up to 2.5 mm long, often thickened, 0.10–0.15 mm wide, frequent. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, smooth, rugulose, papillate or rarely veined, with cracks; *marginal zone* brown, lustrous, 4–9 mm wide, naked or in part rhizinate, with an attenuated limit, smooth to slightly rugose or with rhizinal papillae; *rhizines* black, simple or rarely furcated, up to 4 mm long, 0.02–0.10 mm wide, abundant, evenly distributed.

Apothecia absent [according to Eliasaro (2001), apothecia laminal, adnate, 2–5 mm in diameter, margin smooth, disc brown, imperforate; *ascospores* 13–18 × 6–10 µm]. *Pycnidia* laminal or more often submarginal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* filiform, 8–12 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema mantiqueirense* is distinguished by the large, conspicuously ciliate lobes, filiform conidia and the absence of propagules.

It is close to *P. latissimum*, an eciliate species with sublageniform conidia.

Apothecia are absent both in the holotype (Hale 1990) and lectotype. However, Eliasaro (2001) found one fertile specimen from Paraná State, Brazil (see above in the description).

In *P. mantiqueirense* some rhizines can occupy part of the marginal zone, mainly in the form of “rhizinal papillae” (Awasthi 1976) or “rhizines in development” (Fleig 1997). This feature was already noted to *Parmotrema internexum* (Nyl.) Hale ex DePriest & Hale (Spielmann & Marcelli 2009).

Distribution: South America, where it was reported to Brazil (Marcelli 2008). In Brazil it was recorded to the States of Minas Gerais (Hale 1990, Fleig 1997, Ribeiro 1998), Paraná (Fleig 1997; Eliasaro 2001) and Rio Grande do Sul (Canêz 2005, Spielmann 2005, 2006).

***Parmotrema margaritatum* (Hue) Hale**

Phytologia 28 (4): 337. 1974.

Parmelia margaritata Hue, Nouvelles Archives du Muséum d'Histoire Naturelle de Paris ser. 4 (1): 193. 1899. – Type: U.S.A, Ohio, corticicolous, leg. *Sullivant* (lectotype: P!).

(Fig. 42)

Holotype description

Thallus brownish (herbarium), sublaciniate, loosely adnate, substrate, 6–17 cm broad. *Sublaciniae* crowded, 5–15 mm wide, *surface* continuous, smooth, opaque to sublustrous, becoming cracked towards the center; apical zone lacinulate, undulated and irregular. *Maculae* effigurate or sometimes punctiform, often joined and covering most of the thallus surface (hypermaculate), and so quite difficult to realize at first sight, laminal, not originating cracks. *Cilia* black, simple, up to 2 mm long, usually thickened, 0.04–0.12 mm wide, frequent. *Lacinules* abundant, simple, dichotomous or irregularly branched, plane, apex usually acute, sometimes truncate, 2.0–10.0 × 0.5–3.0 mm. *Soralia* whitish, orbicular, subapical on the lacinules, which can become involute as the soralia grows and become confluent; *soredia* farinose to subgranular. *Pustules* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, smooth to slightly

rugose or papillate, rarely veined, with abundant cracks; *marginal zone* dark brown, lustrous, 1–5 mm wide, naked, with an attenuated limit, smooth, slightly rugose or papillate; *rhizines* black, monomorphic, up to 2.5 mm long, 0.01–0.40 mm wide, simple or irregularly branched, especially near the apices, few, distributed in groups.

Apothecia unknown. *Pycnidia* submarginal to laminal and restricted to the lacinules, conspicuous, usually with prominent margin, abundant, ostiole black; *conidia* filiform, 10–15 (–18) × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema margaritatum* is distinguished by the abundantly lacinulate thallus, the soralia orbicular or confluent growing on the lacinules, the effigurate maculae usually becoming hypermaculate, the thickened and simple cilia and the black undersurface, with a dark brown and erhizinate marginal zone.

Also sorediate, *P. petropoliense* has pustuloid raised structures that give rise to soredia, long (up to 3 mm) and frequently furcated cilia, brown undersurface with dichotomous rhizines and effigurate maculae.

The holotype collection is composed by six thalli. Three of them are glued in a paper, in one sheet (PC0116176) and three are not glued, in other sheet (PC0116177). Both have full indications of collector, Hue's handwriting, etc., and actually, they are very similar in all features. Hale (1965) illustrated only part of the larger specimen from the sheet PC0116177, and so if a lectotype must be chosen, this is probably the best choice, since the undersurface can also be adequately studied.

Distribution: Asia (Awasthi 1976, Chen *et al.* 2005, Divakar & Upreti 2005), North America (Hale 1965, Taylor 1967, Brodo *et al.* 2001) and South America, where it was reported to Venezuela (Feuerer 2008) and the State of Rio Grande do Sul in Brazil (Canêz 2005).

***Parmotrema masonii* Ferraro**
Hickenia 1 (34): 191. 1979.

Type: Argentina, Prov. Corrientes, Depto. Concepción, Paso Crucecita, 20-VI-1974, leg. *L.I. Ferraro* 215 (holotype: CTES!; isotype: US!; paratype: CTES!).

(Fig. 43)

Holotype description

Thallus yellowish, lobate, loosely adnate, corticicolous, 10 cm broad. *Lobes* irregularly branched, laterally overlapped, 2–10 mm wide, *surface* continuous, smooth, opaque, becoming strongly rugose and cracked towards the center; apical zone rounded; margin crenate, sometimes with deep sinuses, undulated. *Maculae* indistinct, punctiform, laminal. *Cilia* black, simple, usually tapered and turning upwards, up to 0.7 mm long, 0.05–0.10 mm wide, frequent. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, sublustrous, smooth, rugose, papillate, with cracks; *marginal zone* dark brown, sublustrous, 1–2.5 mm wide, naked, with an attenuated limit, smooth, rugose or papillate; *rhizines* black, simple or rarely branched, up to 1.5 mm long, 0.02–0.05 (–0.10) mm wide, abundant, ± evenly distributed.

Apothecia cupuliform, 0.5–5.5 mm in diameter, short-stipitate, usually submarginal, margin crenate, frequently involute, amphithecium smooth to irregular or rugose, pruinose, disc brown, slightly pruinose, imperforate; *ascospores* ellipsoid to ovoid, 15–16.5 × 7.5–8.0 µm, episporium ca. 1 µm. *Pycnidia* submarginal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* filiform, 7–12 × ca. 1.0 µm.

Color tests: cortex K+ yellowish, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: usnic acid (minor), salazinic acid (major), consalazinic acid (minor), hypoconstictic acid (minor).

Remarks: *Parmotrema masonii* is characterized by the short cilia (up to 0.7 mm), the presence of salazinic and hypoconstictic acid and the absence of propagules.

Related species include *P. delicatulum* (longer cilia and with different chemistry), *P. flavescens* (isidiate), *P. mirandum*, *P. nylanderi* and *P. pectinatum* (sorediate).

The holotype of *P. masonii* has the upper surface strongly rugose (resembling that of *P. madylinae*), short and tapered cilia. The isotype agrees very well with the holotype, except that it has slightly shorter ascospores 13.5–15 µm long and apothecia frequently irregularly “coronate” with black dots, probably formed by some parasitic fungus. The paratype received from CTES presents several differences in the relation to the holotype and isotype: 1) larger, lacerate apothecia (up to 8 mm in diameter); 2) smaller ascospores, 10–12.5 × 6–7.5 µm, episporium 0.5–1.0 µm; 3) upper surface only slightly rugose and 4) cilia usually thinner and longer (up to 1.5 mm). Nevertheless, the conidia and overall morphology are similar.

The specimen from São Paulo (Marcelli & Barbosa 35720) shares the same chemistry of *P. masonii*, but also has thinner and longer cilia (up to 1.5 mm) and the upper surface is only slightly rugose. It does not produce apothecia but the conidia data (filiform, 8–11 × ca. 1µm according to a label from P. Jungbluth dated 2005) agrees roughly with the measurements from the holotype. Since we did not have access to a rich collection of this species, it is premature to assign these differences to different taxa by the time.

Distribution: South America, where it was recorded to Argentina (Ferraro 1979), Brazil (Fleig 1997) and Paraguay (Fleig 1997). In Brazil it is known for the States of Rio Grande do Sul (Fleig 1997) and São Paulo (Jungbluth 2006).

Additional specimens examined: Argentina, Prov. Corrientes, Depto. Concepción, Paso Crucecita, on *Sapium* sp. (*Euphorbiaceae*), 20-VI-1974, leg. *L.I. Ferraro* 206 (CTES-78596). Brazil, São Paulo State, Municipality of São Manuel, Fazenda Palmeira da Serra, private cerrado protected area, on tree trunk in the woods edge, 03.VI.2003, leg. *M.P. Marcelli* & *S.B. Barbosa* 35720 (SP).

***Parmotrema maximum* (Hue) Spielmann & Marcelli, comb. nov.**

Parmelia maxima Hue, Nouvelles Archives du Muséum d'Histoire Naturelle de Paris, ser. 4 (1): 193. 1899. – Type: Mexico, Chimaleapa n, Cerro de Santiago, near Lerma, apparently saxicolous, 26.VI.1890, leg. *Maury* 3318 (holotype: P!).

(Fig. 44)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, probably saxicolous, 13.5–17 cm broad. *Lobes* irregularly branched, laterally overlapped to ± crowded, 0.5–25 mm wide, *surface* continuous, smooth or with rounded tiny depressions, lustrous, becoming irregularly cracked towards the center; apical zone rounded; margin broadly crenate to lacinulate, undulated to sinuous. *Maculae* absent or irregular and conspicuous in some lobes. *Cilia* black, simple to furcated or dichotomous, up to 2.5 mm long, usually thickened, 0.04–0.10 mm wide, frequent. *Lacinules* simple to dichotomous, plane, apex usually rounded, sometimes truncate or acute, up to 5 mm long, 0.5–5.0 mm wide. *Pustules* and *isidia* absent. *Soralia* linear continuous or sometimes growing backwards or becoming labriform, marginal and on the lacinules apices; *soredia* farinose to granular. *Medulla* white. *Undersurface* black, lustrous, smooth to rugose or papillate; *marginal zone* absent (black) or brown to dark brown, lustrous, 2–6 mm wide, naked, with an attenuated limit, smooth, slightly rugose or papillate, with cracks; *rhizines* black, usually simple, less frequently irregularly branched, up to 3 (–4) mm long, 0.01–0.10 (–0.20) mm wide, abundant, irregularly distributed.

Apothecia plane (pressed down), 1–2.3 cm in diameter, apparently substipitate, margin smooth to incised or lacerate, amphithecium maculate, with irregular depressions or rugose, disc dark brown, epruinose, perforate or not; *ascospores* ellipsoid, 12.5–15 × 7–9 µm, episporium ca. 1 µm. *Pycnidia* submarginal, little conspicuous, without prominent margin, few, ostiole black; *conidia* short-filiform, 7–10 × ca. 1 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema maximum* is characterized by the presence of marginal soralia, occurring also at the apices of the lacinules, the broad nude under margin, the size of ascospores and the short-filiform conidia.

This species was up to know include in the synonymy of *P. stuppeum*, which however do not develop lacinules and additionally has sublageniform conidia (Nash & Elix 2002b). More similar morphologically is *P. margaritatum* (see Hue 1899, Hale 1979), however distinct by the effigurate maculae.

The holotype is composed by two thalli, one of them bearing several apothecia and labeled “32”. It was clearly cut off at the middle. The second thallus is quite similar to the first, however no apothecia are present, and it is not part of the first thallus. Morphologically and chemically the two thalli agree well.

Distribution: Mexico (Hue 1899).

***Parmotrema mirandum* (Hale) Hale**
Phytologia 28 (4): 337. 1974.

Parmelia miranda Hale, Contributions from the United States National Herbarium 36 (5): 273. 1965. – Type: Mexico, State of Oaxaca, northwest of Tehuantepec, Km 686 on highway 190, Pine-scrub oak mountainside, on deciduous trees, elev. 1160 m, 31.III.1960, leg. *M.E. Hale* & *T.R. Soderstrom* 20653 (holotype: US!; isotypes: COLO!, DUKE!, LISU, MSC!, REN, S!, TNS!).

(Fig. 45)

Holotype description

Thallus yellowish, lobate, ± adnate, corticicolous, 5.5–11.0 cm broad. *Lobes* irregularly branched, laterally overlapped to ± crowded in the center, 4–9 mm wide, *surface* continuous, smooth to slightly scrobiculate or rugose, opaque, becoming irregularly cracked in some areas; apical zone rounded, often pruinose; margin broadly crenate, sometimes more incised, undulated. *Maculae* inconspicuous, irregular. *Cilia* black, simple or rarely furcated, 0.2–1.0 (–1.5) × 0.03–0.05 mm, frequent. *Soralia* marginal and usually extensive, also in the apices of the sublacinules, turning the lobe apices involute; *soredia* subgranular. *Lacinules*, *pustules* and *isidia* absent. *Medulla* white or with red stains in some areas (salazinic acid in decomposition). *Undersurface* black, lustrous, rugose, papillate or rarely veined, with cracks; *marginal zone* brown or sometimes pale brown or with beige stains, lustrous, 1–4 mm wide, naked, with a sharp limit, smooth, rugose or papillate; *rhizines* black, simple, 0.2–1.5 × 0.01–0.05 mm, abundant, evenly distributed in the distal parts but absent in large areas at the center.

Apothecia unknown. *Pycnidia* (from the MSC isotype) submarginal, conspicuous, with prominent margin, rare, ostiole black; *conidia* short-filiform, 6–9 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC: usnic acid (minor), salazinic acid (major), consalazinic acid (minor), hypoconstictic acid (minor).

Remarks: *Parmotrema mirandum* is recognized by the yellowish (usnic acid) sorediate thallus with salazinic acid and hypoconstictic acid. The discovery of hypoconstictic acid in this species places it close to *Parmotrema masonii*, suggesting it as the sorediate pair.

The holotype consists of three well developed thalli, and by the great abundance of isotypes (some also with two or three thalli), one can assume the species was quite abundant in the type locality.

About 20 supposed pycnidia (it is difficult to prove if they will produce conidia or not, since they are actually only black dots in the surface, and at the microscope no special structure can be seen) were examined from the holotype; however, no conidia were found. Only one “true” pycnidium was found in the isotype from MSC, from where the measurements were obtained.

The examined isotypes are similar in the overall morphology to the holotype, but some particularities can be pointed: the isotype from TNS has more distinct beige marginal zones in the undersurface, and they seem to be clearly associated with the lobes that produce soralia. The same is true to the isotype from MSC, which additionally has wider lobes, up to 14 mm wide. Large lobes (equally up to 14 mm) were found in the isotype from S. Finally, the isotype from DUKE develops some strongly rugose pustulate-like areas in the thallus center.

Distribution: North America (Hale 1965), and South America, where it was recorded to Brazil and Venezuela (Feuerer 2008). In Brazil it is known for the States of Minas Gerais (Ribeiro 1998), Paraná (Eliasaro 2001) and São Paulo (Ribeiro 1998).

***Parmotrema neotropicum* Kurok.**
Mycotaxon 5 (2): 437. 1977.

Type: Mexico, State of Chiapas, Pine-oak forest on mountainside, 2120 m alt., Km. 1145 on highway 190, west of San Cristóbal, on conifers, 25.III.1960, leg. *M.E. Hale* & *T.R. Soderstrom* 20190 (holotype: US!).

≡ *Rimeliella neotropica* (Kurok.) Kurok., Annals of the Tsukuba Botanical Garden 10: 6. 1991.
≡ *Canomaculina neotropica* (Kurok.) Elix, Mycotaxon 65: 477. 1997.

(Fig. 46)

Holotype description

Thallus buff yellowish, lobate, adnate to loosely adnate, corticicolous, 9.5 cm broad. *Lobes* irregularly branched, ± crowded, 3–12 mm wide, *surface* continuous, with rounded depressions or cracked, smooth, sublustrous, becoming rugose and cracked in the center; apical zone rounded; margin crenate-incised, undulated. *Maculae* weak, effigurate, laminal, not originating cracks. *Cilia* black, simple or rarely furcated, up to 1.2 mm long, 0.02–0.10 mm wide, few. *Isidia* concolor to the thallus or paler, apex usually dark brown, simple to coralloid, up to 1.0 mm high, 0.05–0.50 mm wide, erect, firm or breaking into soredioid granules, sometimes with lateral cilia, laminal or more usually submarginal to marginal. *Lacinules*, *pustules* and *soredia* absent. *Medulla* white. *Undersurface* dark brown to brown, lustrous or opaque, abundantly veined, without cracks; *marginal zone* absent; *rhizines* black, dimorphic, the shorter ones simple and usually curled, up to 1 mm long, 0.01–0.05 mm wide, abundant, evenly distributed; the longer ones up to 4 mm long, 0.05–0.15 mm, usually irregularly branched, especially near the apex, few, distributed in groups.

Apothecia unknown. *Pycnidia* submarginal, conspicuous, without prominent margin, rare, ostiole black; *conidia* filiform, 7–11 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), usnic acid (minor), isousnic acid (minor), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema neotropicum* is distinguished by the isidiate thallus, the isidia sometimes breaking up in soredioid granules, the effigurate maculae, the abundantly veined, brown undersurface with dimorphic rhizines and the presence of usnic acid.

It can be confused with *P. subtinctorium*, but in this species the isidia remain entire, the undersurface is only slightly rugose to papillate, the usnic acid is absent, and produces norlobaridone in the medulla.

The holotype is composed by two distinct thalli (i.e., not parts of the same thallus) that agree with each other in all important features.

Distribution: Brazil (Marcelli 2008), Cuba, Mexico, U.S.A (Hale 1977, Kurokawa 1991). In Brazil it was reported to the States of Goiás (Kurokawa 1991), Minas Gerais (Ribeiro 1998),

Paraná (Donha 2005), Pernambuco, Rio de Janeiro (Kurokawa 1991), Rio Grande do Sul (Fleig 1997) and São Paulo (Marcelli 1992, Marcelli & Benatti 2008).

***Parmotrema nudum* (Hue) Spielmann & Marcelli, comb. et stat. nov.**

Parmelia reticulata f. *nuda* Hue, Nouvelles Archives du Muséum d'Histoire Naturelle de Paris, sér. 4 (1): 177, plate V, fig. 2. – Type: Uruguay, prope Montevideo, Cerro Melones, saxicolous, 1875 and 1876, leg. *Fruchart* s.n. (lectotype: P!).

(Fig. 47)

Holotype description

Thallus brownish, sublaciniate, apparently loosely adnate, saxicolous, 6–11 cm broad; *sublaciniae* irregularly branched, crowded, (1–) 2–6 mm wide, *surface* continuous, reticulate, irregularly cracked towards the centre, smooth to strongly rugose and forming pustules; apical zone truncate or slightly rounded, sometimes acute; margin usually broadly sinuous, plane to undulated. *Maculae* distinct, reticular, laminal, originating cracks that take part in the formation of the pustules; *Cilia* black, simple, 0.2–0.9 mm, abundant. *Pustules* rugose to shapeless, laminal, remaining entire, often formed in the areolae contact. *Lacinules*, *soredia* and *isidia* absent. *Isidia* absent. *Medulla* white. *Undersurface* not well studied [thallus pasted in a paper card, description based on just a small part of one thallus] lustrous, smooth to rugose, with cracks; *marginal zone* dark brown, lustrous, up to 4 mm wide, rhizinate, with an attenuated limit, smooth or papillate; *rhizines* black, usually simple, up to 1 mm long, 0.01–0.05 mm wide, abundant, more or less evenly distributed.

Apothecia sometimes plane (probably pressed down) to more commonly concave, cupuliform or urceolate, up to 7 mm in diameter, substipitate, laminal, margin smooth to strongly pustulate, sometimes lacerate, amphithecium strongly maculate near the border, smooth, rugose (at times strongly) or pustulate, disc dark to light brown, epruinose, imperforate or rarely perforate at maturity; *ascospores* ellipsoid to oblong, 12–14 × 7.5–9.0 µm, episporium ca. 1 µm. *Pycnidia* mainly submarginal, conspicuous, usually with prominent margin, abundant, ostiole black; *conidia* filiform 9.0–12.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema nudum* can be distinguished by the reticular maculae and laminal pustules.

This species was up to know considered a synonym of *P. reticulatum* (Hale & Fletcher 1990). However, the pustular upper surface and absence of soredia are sufficient features to distinguish these two species easily.

It can be more properly compared with *P. granulare*, which has abundant lacinules but produces soredia, and *P. ruminatum*, an eciliate species where the pustules sometimes flakes off the areolae.

The lectotype is well-preserved and developed, although glued to a paper, so that the underside could not be completely described.

Distribution: Uruguay (Hue 1899).

***Parmotrema nylanderi* (Lynge) Hale**
Smithsonian Contributions to Botany 33: 54. 1976.

Parmelia nylanderi Lynge, Arkiv för Botanik 13 (13): 82. 1914. – Type: Brazil, Mato Grosso, Serra da Chapada [nowadays Municipality of Chapada dos Guimarães], near São Jeronymo, supra rupes apricas, 03.VI.1894, leg. *G.O.A. Malme* 2747 (holotype: S!).

≡ *Parmelina nylanderi* (Lynge) Hale, Phytologia 28 (5): 483. 1974.

(Fig. 48)

Holotype description

Thallus yellowish, lobate, loosely adnate, saxicolous, 6.0–7.5 cm broad. *Lobes* irregularly branched, laterally overlapped, 1.0–4.5 mm wide, *surface* continuous or cracked, smooth, lustrous in the young regions, becoming dull rugose and cracked towards the center; apical zone rounded; margin crenate, marked by a distinct black line, sometimes sublacinulate, undulated. *Maculae* absent. *Cilia* black, simple or rarely bifurcated near the apex, usually short, and sometimes thickened, 0.2–1.0 (–1.5) × 0.05–0.10 mm, frequent, although in some lobes totally absent. *Pustules* rugose or orbicular, or multiform, submarginal extensive, usually arranged in groups and advancing over the lamina, originating granular soredia. *Lacinules* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, smooth or rarely rugose, with cracks; *marginal zone* brown, lustrous, 1–2 mm wide, naked, with a sharp or attenuated limit, usually smooth, less frequently slightly rugose or papillate; *rhizines* black, simple, furcated or less frequently dichotomous, up to 2 mm long, thin to thickened, 0.02–0.10 mm wide, abundant, irregularly distributed.

Apothecia unknown. *Pycnidia* submarginal, inconspicuous, without prominent margin, few, ostiole black, immature; *conidia* not found (ca. 20 pycnidia examined).

Color tests: cortex K–, UV–; medulla K+ yellow → blood red, C+ rose, KC+ reddish rose, P+ strong yellow, UV–.

Chemistry: usnic acid (minor), salazinic acid (major), consalazinic acid (minor), hypoconstictic acid (minor), gyrophoric acid (minor).

Remarks: *Parmotrema nylanderi* is distinguished by the lobate yellowish thallus (usnic acid), the presence of salazinic acid and gyrophoric acid in the medulla (K+ yellow → red, C+ rose) and the production of pustules.

Another close species, which also produces pustular soredia, is *Parmotrema pectinatum*. It differs by the laciniate thallus with narrow laciniae (0.8–3.0 mm) copiously ciliate at the margins. Apothecia and conidia are unknown, however, and since they are also unknown in *P. nylanderi*, further collections are necessary to establish more concretely the relations of these two species.

Another species with salazinic acid and usnic acid do not have gyrophoric acid: *P. mirandum* (sorediate), *P. delicatulum* and *P. masonii* (without propagules) and *P. flavescens* (isidiate).

The holotype of *P nylanderi* is constituted by four pieces, and could well be part of the same thallus. In the protologue (Lynge 1914) the thallus size is 6–7 cm. But this lichen was collected by Malme several years earlier, in1894, and could well have cracked before the description.

Although Hale (1960) first defined the specimen *Malme* 2747 as holotype, later on (Hale 1976) he considered it to be a lectotype. However, since it is the only specimen recorded in the protologue (Lynge 1914), and as apparently there are no additional types, it must be categorized as holotype, according to the Article 9.1 Note 1 of the *Vienna Code* (McNeill *et al.* 2007).

Distribution: known only for Brazil, where it was recorded to the States of Minas Gerais (Ribeiro 1998), Mato Grosso (Lynge 1914, Hale 1960) and São Paulo (Hale 1976, Jungbluth 2006). The record from Ribeiro (1998) needs to be reinvestigated, since it has negative thallus reactions (Jungbluth 2006).

***Parmotrema parahypotropum* (W.L. Culb.) Hale**
Phytologia 28 (4): 338. 1974.

Parmelia parahypotropa W.L. Culb., The Bryologist 76 (1): 29. 1973. – Type: Taiwan (Formosa), Kural, 250 malt., 01.II.1964, leg. *Kurokawa* 1487 (holotype: TNS!, isotype: DUKE!).

(Figs. 49-50)

Holotype description

Thallus pale brownish (herbarium), sublaciniate?, extensively lacinulate, loosely adnate, 5.5 cm broad. *Sublaciniae* dichotomous or irregularly branched, laterally overlapped to ± crowded, 1.5–5.0 mm wide, *surface* continuous or sometimes with irregular depressions, smooth, opaque, becoming slightly rugose and cracked towards the center; apical zone rounded when without lacinules; margin sinuous-incised or more commonly lacinulate, undulated. *Maculae* distinct, effigurate, laminal, rarely originating cracks. *Cilia* black, simple or furcated, up to 1.5 mm long, 0.03–0.08 mm wide, frequent. *Lacinules* abundant, usually dichotomous, plane, apex rounded, truncate or acute, 1.0–6.0 × 0.5–2.0 mm. *Soralia* white, growing from the margin of the lobes and becoming extensive towards the undersurface, the sorediate lobes becoming crescent-shaped and crisped; *soredia* farinose to subgranular. *Pustules* and *isidia* absent. *Medulla* white. *Undersurface* black to dark brown in some lobes, beige under the lacinules (probably white in fresh material), lustrous, smooth or with reticulate veins, with few cracks; *marginal zone* brown or beige under the lacinules, lustrous, 1–3 mm wide, naked, with an attenuated limit, usually slightly rugose or veined; *rhizines* black or rarely with pale brown apices, simple, usually glued to each other, up to 1 mm long, 0.02–0.10 mm wide, abundant, irregularly distributed.

Apothecia unknown. *Pycnidia* submarginal to laminal, conspicuous, with or without prominent margin, few, ostiole black; *conidia* unciform, 4–5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → slowly red-orange, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (minor), salazinic acid (minor), norstictic acid (major), galbinic acid (major), consalazinic acid (trace).

Remarks: *Parmotrema parahypotropum* is characterized by the lacinulate thallus with marginal soralia, that grow towards the undersurface, the effigurate maculae, unciform conidia and complex medullar chemistry, with salazinic acid, norstictic acid and galbinic acid .

Soralia ontogeny is very similar to that found in *P. subsumptum*, the sorediate lacinules usually becoming crescent-shaped or crisped. But the abundant lacinules, chemistry, conidia type, furcated cilia and absence of dimorphous rhizines can be used to set these species apart.

P. parahypotropum is the only known species with salazinic acid and unciform conidia, this last feature here being reported for the first time.

Distribution: Africa (Krog & Swinscow 1981, Kurokawa 2003, Aptroot 2008), Asia (Culberson 1973) and Australia (Elix 1994).

Parmotrema paramoreliense **W.L. Culb. & C.F. Culb.**
The Bryologist 84 (3): 311. 1981.

Type: Mexico, Michoacán, 33 Km E of Uruapan on the road to Patzcuaro, pine-oak woods, on a fallen branch of *Pinus* sp., 28.XII.1978, leg. *W.L. Culberson* & *C.F. Culberson* 18171 (holotype: DUKE!).

(Figs. 51-52)

Holotype description

Thallus pale buff (herbarium), laciniate, loosely adnate, corticicolous, 8 cm broad. *Laciniae* dichotomous or irregularly branched, laterally overlapped to somewhat crowded, 1.0–5.5 mm wide, *surface* continuous, smooth, opaque to sublustrous, becoming cracked in the center; apical zone acute or sometimes truncate; margin sinuous, plane, with a strong black line (Fig. 52). *Maculae* distinct, effigurate or sometimes forming strong rounded spots, laminal, originating cracks or not. *Cilia* black, simple or sometimes furcated, up to 5 mm long, usually thickened, 0.05–0.20 mm wide, frequent. *Soralia* capitate, orbicular or forming irregular agglomerations, subapical or laminal; *soredia* subgranular. *Lacinules*, *pustules* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, smooth to rugose, with cracks, widely naked; *marginal zone* absent or brown, lustrous, 1–5 mm wide, naked, with a sharp or attenuated limit, smooth to slightly rugose; *rhizines* black, irregular in size and ramification, simple to variously branched, up to 5 mm long, thin or thickened, 0.01–0.30 mm wide, sparse.

Apothecia unknown. *Pycnidia* submarginal or laminal, rare, ostiole black; *conidia* not found (five pycnidia examined).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema paramoreliense* can be recognized by the laciniate, sorediate thallus, effigurate maculae (Fig. 52), black and widely naked undersurface, long cilia (up to 5 mm) and variedly branched, sometimes very thick rhizines (up to 0.3 mm).

This is a strange species inside the group of *Parmotrema* with salazinic acid, being probably more related to the genus *Everniastrum* Hale ex Sipman. Although the effigurate maculae and dimorphic rhizines could place *P. paramoreliense* together with the species of the former genus *Rimeliella*, the remaining features have no parallel in this group. Future investigations in the ascospores and conidia, not known up to now, can help to clarify the positioning of this taxon.

Although Culberson & Culberson (1981) asserted that pycnidia are relatively common in this species, they are rare in the holotype, and no conidia could be seen.

Distribution: Americas (Culberson & Culberson 1981).

***Parmotrema pectinatum* Jungbluth & Marcelli**
Bibliotheca Lichenologica 96: 220. 2007.

Type: Brazil, São Paulo State, Municipality of Itirapina, SP-225 Road, Km 111, on a large red arenite rock emergent above the cerrado forest canopy, in direct sunlight, 22°15′S, 47°49′W, 770 m alt., 16.VI.1979, *M.P. Marcelli*, *K. Kalb* & *A.E. Luchi* 16077 (holotype: SP!).

(Fig. 53)

Chemistry: usnic acid, salazinic acid, consalazinic acid and gyrophoric acid (Marcelli *et al.* 2007).

This species was recently described for São Paulo State (Marcelli *et al.* 2007) and is characterized by a laciniate thallus with narrow laciniate (0.8–3.0 mm), and abundantly ciliate lobes. It is close to *P. nylanderi*, especially regarding the chemistry and the soredia produced from pustules. See comments under this species for more details.

Additional specimens examined: Same data as from the holotype, *M.P. Marcelli*, *K. Kalb* & *A.E. Luchi* 16075, 16079 (SP).

***Parmotrema permaculatum* (Hale) Kurok.**
Bulletin of the National Science Museum Tokyo, Ser. B, 27 (1): 8. 2001.

Parmelia permaculata Hale, Phytologia 21 (6): 425. 1971. – Type: Mexico, State of Veracruz, 9 Km East of Jalapa along highway 140, 1240 m alt., open pasture, scattered cactus and *Acacia*, on deciduous trees, 13.III.1960, leg. *M.E. Hale* & *T.R. Soderstrom* 19406 (holotype: US!; isotypes: DUKE!, S, TNS, UPS).

(Fig. 54)

Holotype description

Thallus milky brown, lobate, loosely adnate, corticicolous, 15 cm broad. *Lobes* irregularly branched, laterally overlapped, 4–17 mm wide, *surface* continuous, smooth or with tiny depressions, lustrous, becoming rugose and reticulately cracked towards the center, sometimes with flaking off areolae; apical zone rounded; margin sinuous to broadly crenate, sometimes with deep incisions, undulated. *Maculae* distinct, effigurate, laminal, originating cracks. *Cilia* black, sometimes pruinose, simple, up to 2 mm long, 0.04–0.10 mm wide, abundant. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, opaque to lustrous (satin-like), smooth, rugulose or papillate, with cracks; *marginal zone* brown, sometimes white mottled, lustrous, 3–7 mm wide, naked, with attenuated limit, smooth to rugulose or minutely veined; *rhizines* concolor to the undersurface or sometimes with whitish apices, simple to irregularly branched, up to 1.5 mm long, 0.01–0.10 mm wide, abundant, evenly distributed.

Apothecia cupuliform, up to 15 mm in diameter, stipitate, laminal to submarginal, margin slightly incised to lacerate, usually involute, amphithecium maculate, smooth to scrobiculate or longitudinally rugose and foveolate; *ascospores* ellipsoid, 13–17 × 7–9 µm, episporium 0.5–1.0 µm. *Pycnidia* submarginal, conspicuous, without prominent margin, frequent, ostiole black; *conidia* filiform, 10–15 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), norstictic acid (trace).

Remarks: *Parmotrema permaculatum* is distinguished by the effigurate maculae, simple cilia, black undersurface and absence of vegetative propagules.

It is morphologically similar to *P. expansum*, which also develops effigurate maculae but has furcated cilia and shorter conidia (7–12 µm).

To compare with another species usually confused in the literature, see comments under *P. eurysacum*.

The isotype of *P. permaculatum* in DUKE was not listed in the protologue (Hale 1971). It is similar in every respect with the holotype, being clearly conspecific, but develops more abundant pycnidia and the venation in the undersurface is more evident.

Distribution: United States and Mexico (Hale 1971, Kurokawa 2001).

Parmotrema petropoliense **(Zahlbr.) Spielmann & Marcelli, comb. nov.**

Parmelia petropoliensis Zahlbr., Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften Wien, Mathematisch-Naturwissenschaftliche 111: 426. 1902. – Type: Brazil, Rio de Janeiro State, Fazenda Inglês prope [Municipality of] Petrópolis, in forest, corticicolous, leg. *Höhnel* 177 (holotype: W!).

(Figs. 55-56)

Holotype description

Thallus pale brown to brown (herbarium), lobate, loosely adnate, corticicolous, 5–7 cm broad. *Lobes* irregularly branched, laterally overlapped to quite crowded, 3–6 mm wide, *surface* continuous or irregularly cracked, smooth or with tiny depressions, lustrous, becoming irregularly rugose and reticulately cracked towards the center; apical zone rounded; margin crenate to incised or lacinulate, undulated. *Maculae* usually weak, distinct in some lobes, effigurate, laminal, originating cracks or not. *Cilia* black, simple or frequently furcated, up to 3 mm long, 0.02–0.10 mm wide, abundant. *Lacinules* usually simple or irregularly branched, plane, apex rounded or ± truncate, 1.0–4.0 × 0.5–3.0 mm. *Soredia* originated from pustuloid raised structures, marginal to subapical, rarely laminal; *soredia* granular, commonly developing into granules, frequently united in agglomerations and forming cilia. *Isidia* absent. *Medulla* white. *Undersurface* pale brown or dark reddish brown, lustrous, smooth, papillate or slightly rugose in some areas, without cracks; *marginal zone* absent or usually darker than the center; *rhizines* black, dimorphic, the shorter ones simple or furcated to dichotomous, usually curled, up to 1 mm long, thin, 0.01–0.04 mm wide, abundant, evenly distributed; the longer ones up to 1.5 mm long, thickened, 0.05–0.10 mm wide, simple or irregularly branched, few, distributed in groups.

Apothecia absent. *Pycnidia* submarginal, inconspicuous, rare, ostiole black; *conidia* not found.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema petropoliense* is recognized by the marginal to submarginal pustuloid raised structures that give rise to soredia, long (up to 3 mm), abundant and frequently furcated cilia, the brown undersurface with dichotomous rhizines and the effigurate maculae.

This species has long been recognized as a synonym of *P. subsumptum*, which has extensive soralia growing in the undersurface. For more details and to differentiate also from *P. margaritatum,* see the comments under *P. subsumptum*.

The holotype collection is constituted by three thalli, glued in a paper card. They are well-preserved and developed, although without apothecia, and one thallus is glued by the upper surface.

Distribution: Brazil, Rio de Janeiro State (Zahlbruckner 1902).

***Parmotrema pontagrossense* (Eliasaro & Adler) Blanco, Crespo, Divakar, Elix & Lumbsch**
Mycologia 97 (1): 157. 2005.

Rimelia pontagrossensis Eliasaro & Adler, Mycotaxon 66: 127. 1998. – Type: Brazil, Paraná State, Municipality of Ponta Grossa, Buraco do Padre, corticicolous, 25°07′S, 50°15′W, 27 January 1996, leg. *S. Eliasaro & M. Adler* 1621 (holotype: UPCB-28650!; isotypes: BAFC-37879!, CANB).
(Fig. 57)

Holotype description

Thallus stramineous (herbarium), lobate, more or less closely adnate, corticicolous, 11 × 7 cm broad. *Lobes* irregularly branched, laterally overlapped to somewhat overlapping, 5–13 mm wide, *surface* continuous or cracked, smooth to rugose and scrobiculate, lustrous, becoming almost completely reticulately cracked in the center; apical zone usually rounded; margin crenate to sublacinulate, slightly plane to undulated. *Maculae* distinct to strong, punctiform to effigurate, laminal, sometimes covering almost all the surface, usually connecting in pseudo-reticular formations. *Cilia* black, simple or more frequently 2-3–furcated or cespitose, 0.2–1.5 × 0.02–0.05 mm, abundant. *Isidia*, *lacinules* and *pustules* absent. *Soralia* marginal, usually interrupted, sometimes extensive, rarely orbicular; *soredia* granular. *Medulla* white. *Undersurface* black, lustrous, rugose or papillate, with some cracks; *marginal zone* dark brown, 1–3 mm wide, naked, rarely papillate or with small rhizines, with an attenuated limit; *rhizines* black, simple, 0.5–2 (-4) × 0.01–0.1 mm, abundant, apparently evenly distributed, but very dense near the marginal zone.

Apothecia unknown. *Pycnidia* submarginal, little conspicuous, without prominent margin, few, ostiole black; *conidia* not found (ca. 20 pycnidia investigated; the isotype from BAFC! has filiform conidia, 9–11 × ca. 1.0 µm).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV+ yellow.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), lichexanthone (minor), lichesterinic acid (major), protolichesterinic acid (major).

Remarks: *Parmotrema pontagrossense* is distinguished by the sorediate thallus with cespitose cilia and by presents a complex chemistry, with salazinic acid, lichexanthone (see comments under *P. ultralucens*) and the lichesterinic and protolichesterinic acids in the medulla.

The branching pattern of the cilia was already well described in the protologue (Eliasaro & Adler 1998). The same pattern can be seen in *Parmotrema spinibarbe*, a close species with the

same overall morphology, but that can be differentiated by the formation of soredia from botryose structures (Fig. 71) as well as by the absence of lichesterinic and protolichesterinic acids. Future collections of fertile material perhaps will provide additional differences between these two species.

The types studied are well developed and completely similar. The undersurface is difficult to access since the thalli are closely adnate to the substrate; however, the free zone close to the margins presented sufficient diagnostic features.

Distribution: known only for Brazil, where it was recorded to the States of Paraná (Eliasaro & Adler 1998, Donha 2005) and Rio Grande do Sul (Canêz 2005).

Parmotrema pseudoreticulatum **(Tavares) Hale**
Phytologia 28 (4): 338. 1974.

Parmelia pseudoreticulata Tavares, Portugaliae Acta Biologica, série B, 1 (1-2): 138. 1945. – Type: Portugal, surroundings of Lisboa, leg. *C. Tavares* (holotype: LSU, syntype, F!).

= *Parmelia perlata* var. *olivaria* Ach., *Meth. Lich.*: 217. 1803. *Nom. rej. prop*. (Hawksworth *et al.* 2003). – Type: Spain, *sine loc.*, on *Olea*, 1971-93, leg. *P.K. A. Schousboë* (lectotype, selected by Hawksworth *et al.* 2003: H-ACH 1327c), fide Divakar *et al.* (2005).
≡ *Parmelia olivaria* (Ach.) Hue, Nouv. Arch. Mus. Hist. Nat. Paris, sér. 4 (1): 195. 1899. Fide Divakar *et al.* (2005).
≡ *Rimelia olivaria* (Ach.) Hale & Fletcher, The Bryologist 93 (1): 28. 1990. Fide Divakar *et al.* (2005).

(Fig. 58)

Syntype description (F)

Thallus buff (herbarium), lobate, apparently loosely adnate, corticicolous, 8.5–7.0 cm broad. *Lobes* irregularly branched, laterally overlapped to somewhat crowded, 4–12 mm wide, *surface* continuous, smooth or irregular, lustrous, becoming rugose and cracked in the center; apical zone rounded, usually concave; margin smooth to crenate or broadly crenate, sometimes deeply incised, undulated. *Maculae* distinct, punctiform or effigurate, sometimes assuming a reticular pattern, laminal, in some areas covering almost all the surface (hypermaculate). *Cilia* black, simple, up to 0.5 mm long, rare. *Soralia* marginal and linear or more commonly laminal and capitate, sometimes extensive; *soredia* subgranular. *Lacinules*, *pustules* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, usually finely rugose, with few cracks; *marginal zone* pale brown, lustrous, 1–5 mm wide, naked or rarely rhizinate, with an attenuated limit, smooth, rugose or papillate; *rhizines* black, simple, up to 1 mm long, abundant, evenly distributed.

Apothecia absent. *Pycnidia* submarginal, conspicuous, without prominent margin, abundant, ostiole black; *conidia* filiform, 8–14 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), protocetraric acid (trace).

Remarks: *Parmotrema pseudoreticulatum* is distinguished by the abundant laminal and capitate soralia, the rare short cilia (up to 0.5 mm), the punctiform to effigurate maculae and the naked under marginal zone.

At first sight, this seems to be a typical *Rimelia*; however, it is easy to verify that the (false) reticulation is formed by the confluence of the maculae, i.e., the maculae are actually punctiform or effigurate as those of *Canomaculina*.

Parmotrema pseudoreticulatum was considered to be a synonym of *P. reticulatum* by Krog & Swinscow (1981), which has distinct reticulate maculae, under marginal zone rhizinate, soralia growing in short lacinules and more frequent cilia. The distinction between them was also molecularly supported (Hawksworth *et al.* 2003, Divakar *et al.* 2005).

The syntype here described was not listed in the pertinent literature. It is well-preserved and developed, although sterile, and glued on a paper card.

Distribution: Europe and Azores (Tavares 1945, Hawksworth *et al.* 2003) and Africa (Divakar *et al.* 2005).

Parmotrema radiatum **(Lynge) Spielmann & Marcelli, comb. et stat. nov.**

Parmelia cetrata Ach. subsp. *radiata* Lynge, Arkiv för Botanik 13 (13): 94. 1914. – Type: Paraguay, Colonia Risso prope Río Apa, corticicolous, 23.IX.1893, leg. *G.O.A. Malme* 1834 (lectotype: S!; duplicate of the lectotype: UPS!).
(Fig. 59)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, corticicolous, 10.5 cm broad. *Lobes* irregularly branched, laterally overlapped, distinctly radial, 3.0–7.5 mm wide, *surface* continuous, smooth, lustrous, frequently pruinose in the lobe apices, becoming slightly rugose and reticulately cracked towards the center; apical zone rounded; margin crenate to sinous-incised, undulated. *Maculae* distinct, reticular to extensive (hypermaculate), laminal, marginal, originating cracks. *Cilia* black, usually squarrose, less frequently simple or furcated, up to 1.5 (–2.0) mm long, 0.03–0.10 mm wide, abundant. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous (satin-like), smooth, sometimes papillate or veined, with abundant cracks; *marginal zone* dark brown, shiny, narrow, 1–2 mm wide, naked or with sparse rhizines, with attenuated limit, smooth or papillate; *rhizines* black, usually strongly squarrose, sometimes irregularly branched or simple, up to 3 mm long, thin to thickened, 0.01–0.15 mm wide , abundant, irregularly distributed.

Apothecia cupuliform, 1–8 mm in diameter, stipitate, submarginal, margin smooth to dentate, amphithecium maculate, smooth to rugose, disc brown, epruinose, perforate at maturity; *ascospores* ellipsoid, 11.0–13 × 7.5–9.0 µm, episporium 1.0–1.5 µm. *Pycnidia* submarginal, rarely laminal, conspicuous, usually with a prominent margin, frequent, ostiole black; *conidia* filiform, 10–15 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), protocetraric acid (trace).

Remarks: the more salient features of *Parmotrema radiatum* are the usually squarrose cilia, the upper surface reticulate-maculate or hypermaculate, the squarrose and richly branched rhizinae and the shiny nude dark brown under margin.

This species was included by Hale & Fletcher in the synonymy of *P. cetratum*. Nevertheless, *P. cetratum* presents only reticular maculae, cilia never squarrose and the marginal zone is totally absent (lectotype: H-ACH).

Lynge (1914) described *Parmelia cetrata* subsp. *radiata* based in one specimen from Brazil and another from Paraguay. The Brazilian taxon belongs to a new species, here described (see *P. bifidum*).

The duplicate of the lectotype agrees very well with the lectotype, including ascospores and conidial data. It is clearly a part of the holotype thallus. However, the chemical analysis could not demonstrate the presence of trace of protocetraric acid.

Distribution: Paraguay (Lynge 1914).

***Parmotrema ramusculum* (Hale) Hale**
Phytologia 28 (4): 338. 1974.

Parmelia ramuscula Hale, Contributions from the United States National Herbarium 36 (5): 261. 1965. – Type: Borneo Island, Malaysia, Sarawak state, Lawas, on a Rubber tree. 31.V.1955, leg. W.M.A Brooke 10031 (holotype: BM!; isotype: L!, US).

(Fig. 60)

Holotype description

Thallus grayish, lobate, loosely adnate, corticicolous, 9.5 cm broad. *Lobes* irregularly branched, 4–10 mm wide, *surface* continuous, smooth, sublustrous, becoming irregularly cracked towards the center; apical zone rounded; margin smooth. *Maculae* weak, punctiform, laminal, more easily seen in young lobes. *Cilia* black, simple, up to 1.3 mm long, 0.04–0.10 mm wide, sparse. *Lacinules* present, forming *arbuscular*, sorediate and pustular *structures*, irregularly branched, usually terete or sometimes flattened, up to 1.5 cm long, individual branches 0.2–1.0 mm wide. *Soredia* whitish, farinose or becoming more compact, developed in the arbuscular structures and in some lobe margins. *True isidia* absent. *Medulla* white. *Undersurface* (based on the L isotype): black, lustrous, smooth to slightly rugose or rarely papillate, with numerous cracks; *marginal zone* absent (black) or eburneus under the lobes that give rise to the arbuscular structures, which are also usually eburneus; *rhizines* black, simple, up to 1 × 0.05 mm, rare, distributed in groups.

Apothecia and *pycnidia* unknown.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *P ramusculum* is recognized by the very distinct arbuscular structures that became entirely sorediate.

Although these structures were already named as “coralloid isidia” (Hale 1965), they probably deserves an own name, “arbuscula”, since are different from anything that could be called “isidia” in another species. Similar structures are found in *P. coralliforme*, although in this case they are usually ciliate and not so sorediate as in *P. ramusculum*. Additionally

P. coralliforme has distinct effigurate maculae, abundant cilia and rhizines and a pale brown marginal zone in the undersurface.

The two other comparable species are *P. flavotinctum* (Hale) Hale (with atranorin only) and *P. fasciculatum* (Vainio) Hale (with a very complex chemistry, without salazinic acid, see Louwhoff & Elix 1999). They need also to be reevaluated before these intriguing structures could be adequately named.

A well-developed and preserved specimen represents the isotype (L). It has subcanaliculate lobes and more commonly furcated cilia, but in the other features is identical to the holotype. Since it is not glued as the holotype, it was used to describe the undersurface.

Distribution: Malaysian Borneo and Philippines (Hale 1965) and Guyana (Sipman 1999).

***Parmotrema reitzii* Hale**

Mycotaxon 5 (2): 439. 1977.

Type: Brazil, Santa Catarina, [Municipality of] Lajes, Locality of Encruzilhada, 950 m alt., on bark, 24.IV.1962, leg. *R. Reitz* & *R.M. Klein* 12927 (holotype: US!).

≡ *Canomaculina reitzii* (Hale) Elix, Mycotaxon 65: 477. 1997.
≡ *Rimeliella reitzii* (Hale) Fletcher, in DePriest & B. Hale, Mycotaxon 67: 205. 1998.

(Figs. 61-62)

Holotype description

Thallus pale brown (herbarium), lobate, loosely adnate, corticicolous, 12–14 cm broad. *Lobes* irregularly branched, laterally overlapped , 0.4–17 mm wide, *surface* continuous, smooth or with ± rounded depressions, lustrous, becoming reticulately cracked and sometimes rugose towards the center; apical zone rounded; margin crenate-incised to sublacinulate, undulated. *Maculae* distinct, effigurate, laminal, originating cracks. *Cilia* black, simple or rarely with a lateral branchlet, up to 1.0 (–1.5) mm long, thin to somewhat thickened, 0.01–0.10 mm wide, frequent to few. *Soralia* whitish, marginal, the soredia usually pilling up to form raised arbuscular or richly branched, partially corticated structures, turning the lobe apices involute, assuming an linear pattern when confluent; *soredia* subfarinose. *Lacinules*, *pustules* and *isidia* absent. *Medulla* white. *Undersurface* pale brown (perhaps white in fresh material), sublustrous, smooth to papillate, without cracks; *marginal zone* absent; *rhizines* black or rarely dark brown, dimorphic, 1) the shorter ones simple or sometimes furcated, usually curled, up to 0.5 mm long, thin, 0.01–0.04 mm wide, abundant, evenly distributed; 2) the longer ones up to 3.5 mm long, thickened, 0.05–0. 20 mm wide, simple or more commonly irregularly branched, especially near the apex, frequent, distributed in groups.

Apothecia and *pycnidia* unknown.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), norlobaridone (minor), loxodin (trace).

Remarks: *Parmotrema reitzii* is recognized by the submarginal soralia, usually raised and forming branched structures, the pale brown to brown underside, with dimorphic rhizines, and the medullar chemistry, with salazinic acid and norlobaridone.

Parmotrema petropoliense produces similar sorediate structures but with different ontogeny, and has distinct lacinules and furcated cilia, besides the absence of norlobaridone.

Another close species is *P. subsumptum* (see comments and table under this species), where the soralia grow in the underside of the crisped lobes, and additionally do not produces norlobaridone.

Kurokawa (1991) placed *P. reitzii* as synonym of *Parmotrema conferendum* Hale, while Fleig (1997) situated it as synonym of *P. subsumptum*. The type of *P. conferendum* was not studied here, but with base in the type of *P. subsumptum* and its synonyms, *P. reitzii* is distinct booth morphologically (especially the soralia ontogeny) and chemically, i.e., by the production of norlobaridone.

Distribution: South America, where it was recorded to Brazil (Hale 1977, Marcelli 2008) and Venezuela (Feuerer 2008). In Brazil it is known to the States of Rio Grande do Sul (Fleig 1997), Santa Catarina (Hale 1977).

Parmotrema reparatum **(Stirton) Blanco, Crespo, Divakar, Elix & Lumbsch**
Mycologia 97 (1): 157. 2005.

Parmelia reparata Stirton, Scottish Naturalist 4: 201. 1877-78. – Type: Australia, Queensland, Cave Mountain near Brisbane, leg. *F.M. Bailey* 16 (lectotype: BM!).

≡ *Canomaculina reparata* (Stirton) Kurok., Bulletin of the National Science Museum Tokyo, Ser. B, 27 (1): 2. 2001.

= *Parmelia virens* Müll. Arg., Flora 69: 255. 1886. – Type: Australia, Queensland, Toowoomba, 1882, leg. *Hartmann* (holotype: G).

(Fig. 63)

Lectotype description

Thallus brown (herbarium), lobate, loosely adnate, corticicolous, 7 cm broad. *Lobes* irregularly branched, laterally overlapped, 3–9 mm wide, *surface* continuous, smooth, lustrous, becoming scrobiculate and irregularly cracked towards the center; apical zone rounded; margin broadly crenate, undulated. *Maculae* distinct, effigurate, laminal. *Cilia* black, simple or rarely furcated, up to 1.5 mm long, 0.04–0.07 mm wide, frequent. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, opaque, extensively veined, without cracks; *marginal zone* absent (i.e., black) or dark brown to brown, then opaque to lustrous, 3–7 mm wide, rhizinate, or papillate; *rhizines* black or dark brown in the marginal zone, dimorphic, the short ones simple and usually curled, up to 0.5 mm long, 0.01–0.04 mm wide, abundant and evenly distributed, the longer ones simple or branched, up to 1.5 mm long, 0.04–0.10 mm, frequent, distributed in groups.

Apothecia cupuliform, 2–13 mm in diameter, stipitate, submarginal, margin smooth to slightly incised or lacerate, usually involute, amphithecium maculate, scrobiculate to longitudinally rugose and with deep depressions, disc brown, epruinose, perforate; *ascospores* subglobose, 10.0–12.5 × 8.0–9.0 µm, episporium ca. 1 µm. *Pycnidia* mainly submarginal, conspicuous, with or without prominent margin, frequent; *conidia* filiform, 9–15 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema reparatum* is recognized by the effigurate maculae, simple cilia, black undersurface, dimorphic rhizines and the absence of vegetative propagules.

Parmotrema subcaperatum is quite similar in overall morphology, but the marginal zone is more distinct, the ascospores larger (14–16 µm), and additionally contains usnic acid.

Parmelia virens has the same overall morphology of *P. reparata*, except by the darker, olivaceous upper surface. Therefore, we are accepting the synonymization proposed by Kurokawa (2001), although some comments are necessary:

When describing *Parmelia reparata*, Stirton (1877-1878) noted ascospores 13–14 × 9–11 µm. The study of the lectotype revealed ascospores briefly shorter and subglobose, 10.0–12.5 × 8.0–9.0 µm, while the holotype of *P. virens* presented still smaller measurements, of also subglobose ascospores, 7.5–12 × 7.0–8.5 µm.

The ascospores size published by Kurokawa (2001), however, are quite distant from these: 15–18 × 6–8 µm. This clearly represents ellipsoid or more probably narrowly ellipsoid ascospores. Apparently this measurement should be referred to the specimens studied.

Unfortunately, full comparisons of the undersurface of *P. reparata* and *P. virens* are not possible, since the lectotype of the first species is almost totally glued to a card.

Kurokawa (2001) postulated that *P. subcaperatum* could be endemic to South America, while *P. reparatum* occurs in Australia and New Zealand. Nevertheless, the specimens at the "halfway", namely Africa (especially that recorded by Krog & Swinscow 1981), still need to be revised to corroborate this hypothesis.

The specimens listed in Hale (1965) to the United States of America and Mexico actually belong to *P. permaculatum*, as already indicated by Hale (1971).The specimens recorded as *Canomaculina* aff. *reparata* by Spielmann (2005) need to be checked, since they have reticular maculae.

Distribution: Oceania (Kurokawa 2001)

***Parmotrema reterimulosum* (Zahlbr.) Spielmann & Marcelli, comb. nov.**

Parmelia reterimulosa Zahlbr., Botanische Jahrbücher für Systematik, Pflanzengeschichte um Pflanzengeographie 60: 520. 1926. – Type: South Africa, Natal, Drackenberge, Van Reenens Pass, leg. *Brunnthaler* s.n. (holotype: WU!).

(Fig. 64)

Holotype description

Thallus brownish (herbarium), lobate, apparently loosely adnate, corticicolous, 7 cm broad. *Lobes* irregularly branched, laterally overlapped to crowded, 2–5 mm wide, *surface* continuous or irregularly cracked, smooth or slightly irregular, lustrous, becoming strongly cracked in the center; apical zone rounded; margin sinuous, undulated. *Lacinules* absent, although the thallus subdivision could be interpreted as forming lacinules. *Maculae* distinct, reticular, laminal, originating cracks. *Cilia* black, simple, up to 1.5 mm long, abundant, at times some "cilia" (rhizines?) growing in the underside of the lobes. *Pustules* absent. *Soralia* whitish, extensive, submarginal and moving on to the center, present also in the apices of the sublacinules; *soredia* granular. *Isidia* absent. *Medulla* white. *Undersurface* black, lustrous, rugose or papillate, with scars; *marginal zone* brown, or dark-brown to black in some areas, lustrous, 1–3 mm wide, naked or with papillate rhizines, with an attenuated limit, smooth to slightly rugose; *rhizines*

black, usually simple, rarely with lateral branches, up to 1.5 mm long, more or less evenly distributed, in some areas the rhizines are strongly curly and entangled e sometimes forming groups of rhizines slightly thickened.

Apothecia pressed down, apparently concave, 1 mm in diameter, substipitate, laminal, margin smooth crenate, amphithecium strongly rugose, disc dark brown, epruinose, perforate; *ascospores* ellipsoid or oblong, 12.5–17.5 × 6.0–7.5 µm, episporium ca. 1.0 µm. *Pycnidia* laminal to submarginal, conspicuous, without prominent margin, frequent, ostiole black; *conidia* filiform, 11–16 (–18) × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema reterimulosum* is recognized by the soredia ontogeny, the reticular maculae, the bare marginal zone and the filiform relatively long conidia (11–18 µm).

This species was proposed by Zahlbruckner (1926), who made important observations and provided a very complete description. Dodge (1959) accepted it, citing several additional specimens. Hale & Fletcher (1990) placed it as synonym of *P. reticulatum*.

However, *P. reticulatum* has a rhizinate under marginal zone, smaller conidia 8.5–12.0 µm long, and the soredia arise from swellings which become defragmented.

In *P. reterimulosum* the, cortex become fragmented into minute areolae, which afterwards give rise to the soredia in extensive soralia. Usually, each areolae give rise to only one soredium. The presence of the soralia apparently turns down the lobe apices. The underside marginal zone is papillate or with very rudimentary immature rhizines, or more commonly naked.

The holotype is constituted by a broken thallus (five parts), and a small envelope with one apothecium. Together there is an isidiate, ciliate lichen, probably with stictic acid (medulla K+ yellow).

Distribution: Africa (Zahlbruckner 1926, Dodge 1959).

***Parmotrema reticulatum* (Taylor) M. Choisy**
Bulletin mensuel de la Société Linnéenne de Lyon 21: 175. 1952.

Parmelia reticulata Taylor, *in* Mackay, J.T., *Flora hibernica*, part second, comprising the Musci, Hepaticae and Lichenes, 1836, p. 148. – Type: Ireland, County of Kerry, near Dunkerron, on rocks, common, leg. *T. Taylor* s.n. (lectotype: FH!, duplicate of the lectotype: BM!).

≡ *Rimelia reticulata* (Taylor) Hale & Fletcher, The Bryologist 93 (1): 28. 1990.

= *Parmelia praeperlata* Nyl., Flora 69: 319. 1886. Type: – French Southern and Antarctic Lands, St. Paul Island, leg. *Fenzl* s.n. (lectotype: H-NYL 35548!).

(Fig. 65)

Duplicate of the lectotype description (BM)

Thallus slightly brownish, lobate, loosely adnate, over rock with mosses, 6.5–7.0 × 4.0–5.0 cm broad. *Lobes* irregularly branched, crowded, 2.0–8.0 mm wide, *surface* continuous or reticulately cracked, smooth, lustrous, usually cracked in the center; apical zone usually subdivided in

lacinules, when entire rounded; margin smooth, broadly crenate, undulated. *Maculae* distinct, reticular, laminal, originating cracks. *Lacinules* simple or bifurcate, present in the whole thallus, plane to slightly canaliculated or rarely concave, usually with the apex involute, often covered by soredia, apex acute or sometimes rounded, 0.5–2.2 × 0.6–1.6 mm. *Cilia* black, usually simple, rare irregularly branched, squarrose or bifurcated in the apex, 0.1–1.0 × 0.02–0.05 (–0.10) mm, few to frequent in the non-sorediate lobes, absent in the sorediate lacinules. *Soralia* subapical in the short lacinules, growing backwards some millimeters in the lamina, becoming labriform in several areas; *soredia* subgranular to farinose, rising from swellings which become defragmented. *Pustules* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, rugose to veined, with scars; *marginal zone* brown or rarely black, lustrous, 0.5–3.0 mm wide, rhizinate, rugose or papillate, with an attenuated limit; *rhizines* black, of two extremes: (1) simple to squarrose, slender (0.02–0.05 mm wide) and usually shorter (0.2–1.3 mm), abundant, evenly distributed, or (2) irregularly branched, especially close to the apices, thickened (0,10–0.25 mm) and longer (0.5–2.0 mm), frequent, distributed in groups.

Apothecia immature (asci and ascospores not formed), infrequent (four found), urceolate, 3.5 mm in diameter, substipitate, laminal, margin dentate, sorediate or in process of soredia formation, amphithecium sorediate, disc beige, epruinose, imperforate. *Pycnidia* laminal to submarginal, conspicuous, without prominent margin, abundant, ostiole black; *conidia* filiform, 8.5–12.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema reticulatum* is characterized by reticular maculae, the presence of submarginal, extensive soralia (which also can occur in the short lacinules) and the production of salazinic acid.

It is part of a complex of species earlier grouped under *Rimelia reticulata*. Some very divergent entities were part of this complex, like pustulate species with reticular maculae (*P. granulare*), sorediate species with effigurate maculae (*P. concors*, *P. livido-tesselatum*) and pustulate species with effigurate maculae (*P. nudum*).

Also sometimes included under *P. reticulatum*, *P. clavuliferum* is distinct by the formation of closed lacinules, sorediate only at the apices.

The rearrangement of the taxa involved lead to the conclusion that the present data on the distribution of *P. reticulatum* cannot be take into account, and probably this species has a much more restrict distribution, maybe only in temperate areas of Europe and North America.

Interestingly the apothecia seen in the types are imperforate. According to Hale & Fletcher (1990), species of *Rimelia* would always have perforate apothecia. Taylor (1967) also found only imperforate apothecia in *Rimelia reticulata*. However, Purvis *et al.* (1992) asserted that they can be sometimes perforate.

The duplicate of the lectotype of *P. reticulatum* is composed of two thalli glued in a paper box. They are similar in soralia, branching, maculation, and conidia size and shape. There are four immature apothecia. Hale & Fletcher (1990) asserted that the ascospores of *Rimelia reticulata* are 13–18 × 8–10 µm. However, it is not known from what specimen or specimens these measures were obtained. The conidia found in the duplicate of the lectotype are shorter (8.5–12.0 µm) than those cited by Hale & Fletcher (1990): 12–16 µm. The soralia in the duplicate of the lectotype reminds *Parmotrema simulans* (Hale) Hale, which have only atranorin and caperatic acid and was once thought to be a chemotype of *P. reticulatum* (Hale & Fletcher 1990).

In the free (not glued) undersurfaces, some thickened rhizines were found, branched and longer in relation to the more common ones. However, a gradual transition between one type to another can be observed.

The lectotype of *P. reticulatum* (FH) is formed by three pieces glued in a sheet. Although agreeing well with the duplicate of the lectotype, it has structures that can resemble schizidia, since they are areolae that can give rise to soredia at their margins. A re-study is necessary to be sure about these data. Also, since it does not have apothecia or pycnidia, we chose to present here the description of the duplicate of the lectotype.

Parmelia praeperlata Nyl., known only from the type locality, was published by Nylander (1875), and a more complete description was presented some years later (Nylander 1886). It is interesting to note that Hale & Fletcher (1990) indicated the paper of Nylander (1886) as the protologue, not Nylander (1875). It was the *Catalogus* (Zahlbruckner 1930a) that called our attention to these papers.

The lectotype of *P. praeperlata* has a strong black, marginal line, and sometimes develops short, branched tapered cilia (up to 0.5 mm), which are a noticeable feature. However, *P. reticulatum* also develops a dark brown to black marginal line and similar branched cilia, although just in some lobes. A label by J.A. Elix, dated November 09, 1998, gives the following chemical data: "TLC solvent C/HPLC: atranorin (minor), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor)". Nylander (1886) reported the conidia of *Parmelia praeperlata* as 9–11 µm. We found it as 8.5–12 × ca. 1 µm. So the same size as *P. reticulatum*.

Since apothecia are lacking or immature in the types of *P. praeperlata* and *P. reticulatum*, additional date could not be compared and so it seems better to keep these species as synonyms, until more specimens be available.

***Parmotrema ruminatum* (Zahlbr.) Blanco, Crespo, Divakar, Elix & Lumbsch**
Mycologia 97 (1): 158. 2005.

Parmelia ruminata Zahlbr. in Magnusson & Zahlbruckner, Arkiv för botanik 31A (6): 107. 1944. – Type: Hawaiian Islands, 200 feet alt. (656 m), leg. *Brother Matthias* 757 (lectotype: W!, selected here).

≡ *Rimelia ruminata* (Zahlbr.) Hale & Fletcher, The Bryologist 93 (1): 28. 1990.

= *Parmelia ramescens* Zahlbr. in Magnusson & Zahlbruckner, Arkiv för Botanik 31A (6): 97. – Type: Hawaii, Maui, Iao Valley, leg. *Faurie* 516 (lectotype: W!; duplicates of the lectotype: BM!, PC).
≡ *Rimelia ramescens* (Zahlbr.) K.H. Moon & Kurok., Journal of Japanese Botany 76: 326.

(Fig. 66)

Lectotype description

Thallus brownish (herbarium), lobate, 10.5 cm broad. *Lobes* irregularly branched, ± crowded, 2–5 mm wide, *surface* continuous to cracked, slightly rugose or irregular, becoming strongly rugose, cracked and pustulate towards the center, sometimes producing areolae that flake off; apical zone rounded, usually pruinose; margin smooth to sinuous or sublobulate, undulated. *Maculae* distinct, reticular, laminal, originating cracks. *Cilia* absent to rare (see comments below). *Pustules* rugose, capitate or elongated, laminal, remaining entire or sometimes flaking off together with the areolae. *Lacinules, soralia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, smooth to rugose, with cracks; *marginal zone* brown, lustrous, 1–2 mm wide,

naked, with an attenuated limit, smooth; *rhizines* black, simple, up to 1 mm long, 0.01–0.04 mm wide.

Apothecia cupuliform, 1–4 mm in diameter, short-stipitate, laminal, margin crenate, pustulate, amphithecium rugose, pustulate, disc brown, epruinose, imperforate; *ascospores* oblong-ellipsoid, 16–20 × 7.5–9.0 µm, episporium 1.0–1.5 µm. *Pycnidia* submarginal, conspicuous, usually without prominent margin, few, ostiole black; *conidia* filiform, 9–13 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC (J. Johnston & G.A. Jenkins, 03.II.1988, label with the lectotype in W): atranorin, chloroatranorin, salazinic acid (major), consalazinic acid (trace), protocetraric acid (trace), unknown RT 5.81 (trace, HPLC only).

Remarks: *Parmotrema ruminatum* is characterized by the strongly pustulate upper surface, from which sometimes areolae are flaked off, and the eciliate lobe margins.

It is related to *P. austrocetratum*, in which the production of areolae is much more evident, giving rise to schizidia, and the cilia are abundant and longer (up to 1.6 mm).

The lectotype of *P. ruminatum* is well developed and shows all features necessary to its description, with exception of the undersurface, since the thallus is strongly glued to a paper card. Although a greenish fungus is abundant in the upper surface, it seems it is not causing any damage to the thallus. Rare black, simple cilia, 0.1–0.6 × 0.02–0.05 mm were found. These look much more as an "accident" (some rhizinate growing in the margin) that true cilia, and so the species is considered eciliate here.

The ascospores of this species, oblong-ellipsoid, are quite uncommon in the *Parmotrema* with salazinic acid. So strange that we first thought the measurements described in Magnusson & Zahlbruckner (1944) could be wrong, but confirmation through the lectotype study then confirmed that data.

The typification revealed some problems. Magnusson & Zahlbruckner (1944) listed two collections, one from Hawaiian Islands (*Brother Matthias*) and one from Hawaii (*Faurie* no. 861). According to a label from Hale (dated 1965), the specimen *Brother Matthias* 757 (W) is the holotype. However, Hale & Fletcher (1990) chose as lectotype "*Brother Matthias* (*Faurie* 861), Hawaii". We do not know where the specimen *Faurie* 861 is preserved, and future studies must trace it to clarify it status. Thus, for practical purposes, the specimen *Brother Matthias* 757 is here being selected as lectotype.

Both the lectotype and duplicate of the lectotype of *Parmelia ramescens* are well developed thalli, the specimen from W being 10 cm broad and the BM specimen 13 cm broad. The upper surface is strongly rugose and pustulate, and some lobes become canaliculated. In the other features they agree well with the holotype of *P. ruminata*, and so are here being treated as its synonym, a position already proposed by Hale & Fletcher (1990). Zahlbruckner (in Magnusson & Zahlbruckner 1944) asserted that he saw a large thallus up to 20 cm broad. Maybe this is the specimen deposited in PC, since we have not received it.

Conidia were found only in the duplicate of the lectotype of *P. ramescens* (BM). They are filiform, 9–14 × ca. 1 µm, so matching the conidia of *P. ruminata*.

Moon *et al.* (2001) proposed *Rimelia ramescens* as a distinct species. The authors asserted that it has "*a rather smooth upper surface*" and "*it lacks pustules and eminent ridges*". This observation, however, do not agree with ours, made on the lectotype and its duplicate. It is possible that they refer to the specimen examined only. The herbarium where the lectotype is hosted is actually W, not TNS, as referred by those authors.

Parmotrema ruminatum has an indeterminate substrate. It was quoted as "saxicolous?" by Magnusson & Zahlbruckner (1944), corticicolous by Moon *et al.* (2001) and finally both in

Smith (1993). This last author, nevertheless, asserted that the species is schizidiate, not pustulate, and so his identification needs to be confirmed.

Distribution: Hawaiian Islands (Magnusson & Zahlbruckner 1944, Smith 1993, Hale & Fletcher 1990, Moon *et al.* 2001).

Parmotrema ruptum **(Lynge) Hale ex DePriest & B. Hale**
Mycotaxon 67: 204. 1998.

Parmelia rupta Lynge, Arkiv för Botanik 13 (13): 40. 1914. – Type: Paraguay, Territory Gran Chaco, ad Rio Negro, 14.IX.1893, corticicolous, leg. *G.O.A. Malme* (holotype: S!).

(Fig. 67)

Holotype description

Thallus brownish (herbarium), lobate, ± adnate, corticicolous, 6 cm broad. *Lobes* irregularly branched to quite crowded in the center, 2–7 mm wide, *surface* continuous or reticulately cracked, smooth to irregular, lustrous, becoming fully reticulately cracked towards the center; apical zone rounded; margin smooth to sublacinulate or lobulate (see comments), undulated. *Maculae* distinct, reticular to hypermaculate, laminal, originating cracks. *Cilia* black, simple or rarely furcated near the apex, short, up to 0.5 mm long, usually thin but sometimes thickened, 0.02–0.10 mm wide, few. *Sublacinulae* or *lobules* simple, few, plane, apex usually acute to rounded, rarely truncate, 0.2–2.0 × 0.2–1.0 mm. *Pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, rugose, subscrobiculate, papillate or veined, with cracks; *marginal zone* dark brown to dark reddish brown, lustrous, 0.5–2.0 mm wide, naked, with an attenuated limit, smooth to slightly rugose; *rhizines* black, usually simple, up to 1 mm long, thin to thickened, 0.02–0.15 mm wide, abundant, evenly distributed.

Apothecia plane to concave or cupuliform, 1.5–5.5 mm in diameter, short-stipitate, usually submarginal, margin smooth, crenate or deeply incised, dividing the apothecium in parts, rarely with small lobules, amphithecium maculate, smooth or rugose, disc pale brown, epruinose, usually rugose at maturity, imperforate although with a central depression; *ascospores* subglobose to ellipsoid, biserial, 10.0–12.5 × 6.0–7.5 µm, episporium ca. 1 µm. *Pycnidia* submarginal or laminal, conspicuous, with or without prominent margin, abundant, ostiole black; *conidia* filiform, 10.0–12.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC (J.A. Elix, 28.XII.2007, label with the holotype): atranorin (minor), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema ruptum* can be recognized by the strongly reticulately cracked upper surface, associated with reticulate maculae (sometimes hypermaculate), the absence of propagules, the short, rare cilia, the naked under margin, usually dark reddish brown, and the production of salazinic acid.

Fleig (1997) considered *P. ruptum* and *P. expansum* synonyms of *P. eurysacum*. However, according the types studied, *P. eurysacum* is emaculate, and *P. expansum* has effigurate maculae.

It also could be confused with *P. cetratum*, which is distinctly rhizinate up to the margin.

The specimens recorded by Canêz (2005) as *Parmotrema ruptum* were studied (SP). They are represented by well-developed thalli. In fact, one thallus is 22 cm broad. The upper surface is

usually strongly maculate (hypermaculate) and whitish, resembling *P. albinatum*, a sorediate species recently described from Hawaii (Moon *et al.* 2001), although in some lobes the reticular maculae are conspicuous. The cilia are quite frequently long (up to 1 mm) and bifurcate, and the thallus is almost uniformly whitish. Nevertheless, the underside is practically identical to the holotype de *P. ruptum*, especially the dark reddish brown under margin and rugose surface. The conidia also are equal. So they are conspecific.

It must be noted that all specimens recorded by Canêz (2005) are saxicolous, while the holotype of *P. ruptum* is corticicolous. Unfortunately, the specimens reported by Canêz (2005) don't developed apothecia, avoiding the comparison of ascospores data.

The holotype of *P. ruptum* is attached to a bark, so some the undersurface features were not described in detail, the observations being based only on the free lobes. The thallus also form some adventitious lobules or sublacinules, rose on the damaged areas. In future collections of this species special attention must be paid in these structures (if present) and also on apothecial margins. They are quite similar to the lobe margins, and maybe it can give rise to apothecial cilia.

Distribution: Brazil (Canêz 2005), Paraguay (Lynge 1914, Hale 1960), Uruguay (Räsänen 1938, Osorio 1972).

Additional specimens examined: Brazil, Rio Grande do Sul, Municipality of Vacaria, Fazenda da Estrela, 28°04′49.2″S, 50°56′36.9″W, 850 m, over basaltic rock, sunny place, 10.I.2004, leg. *L.S. Canêz* & *A.A. Spielmann* 1020, 1021, 1035, 1080 (SP).

Parmotrema sieberi **(C.W. Dodge) Spielmann & Marcelli,** ***comb. nov.***

Parmelia sieberi C.W. Dodge, Annals of the Missouri Botanical Garden **46**: 148. 1959. –Type: Mauritius, leg. *Sieber*, Crypt. Exot. 44, corticole, ex herb. Sbarbaro (holotype and isotype: FH!).

= *Parmelia claudelii* (Harm.) Vainio var. *clemensiae* Vainio, Phil. Journ. Sci. 4: 659. 1909. – Type: Philippines, Mindanao, Lake Lanao, leg. *Clemens* 1319 (lectotype: TUR, Vainio herb. n° 2542).

(Fig. 68)

Holotype description

Thallus brown, lobate, loosely adnate, apparently corticicolous, 45 cm broad. *Lobes* irregularly branched, laterally overlapped, 8–25 mm wide, *surface* continuous or less frequently cracked, usually smooth, lustrous, becoming rugose and cracked in the center; apical zone rounded; margin smooth or sparsely crenate, undulated. *Cilia* black, simple or furcated, sometimes more branched, up to 2 mm long, frequent, less dense in the lobe apices. *Maculae* absent. *Soralia* usually concolor to the thallus or more pale, linear continuous or interrupted, sometimes with a tendency to become extensive or labriform, or then orbicular in the apex of small lateral growths (lacinules?), usually marginal, rarely laminal, in apothecial primordia; *soredia* granular. *Lacinules*, *isidia* and *pustules* absent. *Medulla* white. *Undersurface* black, lustrous, smooth to rugose or papillate, with scars; *marginal zone* brown, lustrous, 3–12 mm wide, naked, with an attenuated limit, smooth, rugose or papillate, sometimes veined; *rhizines* black, simple, up to 1 mm long, frequent, distributed in groups.

Apothecia concave/ cupuliform, up to 3 mm in diameter, stipitate, laminal, margin sorediate, amphithecium sorediate, disc dark brown, epruinose, imperforate; *epithecium* 10–12 µm; *hymenium* 30–34 µm; *subhymenium* 12–14 µm; *ascospores* ellipsoid, 25–28 × 15–18 µm,

episporium 2–3 µm. *Pycnidia* laminal, conspicuous, without prominent margin, few, ostiole black; *conidia* not found (ca. 30 pycnidia investigated).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema sieberi* is characterized by the sorediate thallus with wide lobes (8–25 mm), the simple to furcated cilia, up to 2 mm long.

It is very similar to *P. cristiferum,* the differences being the presence of well developed cilia, wider lobes, soralia not so crisped and the absence of eumitrins. These features seem suitable for species separation at the present time.

On the other hand, the ascospores are similar, and one of the specimens determined as *P. sieberi* by Dodge (Mauritius, *Wight* s.n., FH!), actually the duplicate of the lectotype of *Parmelia cristifera*, has sublageniform conidia, 5–7 × ca. 1 µm, equal to that described for *Parmelia cristifera* (see Vainio 1909a). The chemistry of the two species is the same.

If we consider *P. sieberi* as synonym of *P. cristifera*, we must do accept that *Parmelia cristifera* could produce well-developed cilia. Krog & Swinscow (1981) already pointed out that occasional, rudimentary cilia could grow in the lobe axils of *P. cristifera*. In *P. sieberi*, however, the cilia are very well developed, seen by the unaided eye.

Krog & Swinscow (1981) described the holotype of *P. sieberi* as a collection from Wight, at Mauritius (FH). Elix, in a label, did the same. The true holotype, however, is “Mauritius, Sieber, Crypt Exot. 44, corticole, ex herb. Sbarbaro, at Farlow Herb.”, as indicated in the protologue (Dodge 1959), by a label from Dodge dated 1957 and another one from Kurokawa dated 1967.

There is also an isotype in FH, smaller than the holotype, but from the same place. It has very few cilia and more crisped soralia, thus it is more adequately treated as *Parmelia cristifera*. Unfortunately, pycnidia were not found.

The absence of pycnidia in the lectotype of *Parmelia cristifera* and in the holotype and isotype of *Parmelia sieberi* leaves a gap, which can be filled, hopefully, with the study of fresh collections.

The lectotype of *Parmelia* var. *clemensiae* Vainio (TUR!) agrees in gross morphology, and conidia (sublageniform, 6–9 × ca. 1 µm) with *P. cristiferum*, although presents also well developed cilia and the chemistry is identical with that of *P. sieberi*, and so is accepted here as a synonym of this last species.

Distribution: Africa (Dodge 1959) and Philippines (Vainio 1909b).

***Parmotrema spinibarbe* (Kurok.) Hale ex DePriest & B. Hale**
Mycotaxon 67: 204. 1998.

Parmelia spinibarbis Kurok., Bulletin of the National Science Museum Tokyo 17 (4): 299. 1974. – Type: Brazil, Rio de Janeiro, [Municipality of] Petrópolis, about 810 m alt., on trees, July 17, 1971, leg. *S. Kurokawa* 8348 (holotype: TNS!; isotypes: DUKE!, G!, O!, US!, W!).

(Figs. 69-71)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, corticicolous, 8–11 cm broad. *Lobes* irregularly branched, laterally overlapped, 3–15 mm wide, *surface* smooth to more often strongly cracked, especially at old parts, rather opaque; apical zone ± rounded; margin crenate to usually incised, undulated. *Maculae* usually strong, although difficult to see at the first sight, since it covers almost all the upper surface, punctiform to irregular, sometimes assuming a pseudo-reticular pattern (by the confluence of the dots), laminal, not originating cracks (as normally occur with real reticular maculae). *Cilia* black, simple to more commonly cespitose, 0.5–1.5 × 0.02–0.1 mm, abundant, apparently friable, since the upper surface is abundantly covered by pieces of cilia. *Soralia* marginal, somewhat extensive toward the centre of the thallus, or forming both laminal and marginal botryose structures fully covered by soredia; *soredia* granular. *Lacinules*, *pustules* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, papillate or rugose, with many cracks; *marginal zone* brown (sometimes absent), lustrous, 0.5–2.0 mm wide, naked, with a sharp limit, smooth to slightly rugose or less frequently papillate; *rhizines* black, simple, 0.3–1.5 × 0.02–0.10 mm, abundant, distributed in groups.

Apothecia plane or concave, 3–10 mm in diameter, shortly stipitate, laminal, margin sorediate, amphithecium maculate, sorediate, disc dark brown, epruinose, perforate at maturity; *ascospores* ellipsoid to broadly ellipsoid, 12.0–13.5 × 7.0–9.0 µm, episporium 1–1.5 µm. *Pycnidia* submarginal, conspicuous, without or with a slightly prominent margin, abundant, ostiole black; *conidia* filiform, 7.5–10.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV+ orange.

TLC in solvent C, HPLC (J.A. Elix, 17.VII.1996, label with the holotype in TNS): atranorin (minor), chloroatranorin (minor), lichexanthone (major), salazinic acid (major), consalazinic acid (trace).

Remarks: *Parmotrema spinibarbe* is characterized by the presence of cespitose cilia (Fig. 70), and the marginal and less frequently laminal soredia, sometimes growing from botryose structures (Fig. 71).

In *P. pontagrossense*, otherwise similar in the cilia branching, cortical chemistry and conidial form and size, the botryose structures are absent from the examined type material (holotype, UPCB, isotype in BAFC). Additionally, it produces lichesterinic and protolichesterinic acids in the medulla. Unfortunately, apothecia are unknown in this species, and so we cannot compare ascospores data.

Parmotrema diffractaicum (Essl.) Hale is morphologically very similar to *P. spinibarbe*, as already noted by Fleig (1997) and Canêz (2005). Chemically, however, they are distinct since *P. diffractaicum* produces diffractaic acid instead salazinic acid.

The holotype of *P. spinibarbe* (TNS) is in very good condition and has conidia and apothecia. All other isotypes seen agree with the holotype in every aspect. However, some notes can be added: (1) the botryose structures are much more abundant in the isotype from G; (2) the isotype from O has the upper cortex damaged in some lobes that resulted in the production of many orbicular atypical soralia; additionally, the marginal cilia are almost entirely cespitose; (3) a well developed perforate apothecium and many botryose structures were observed in the isotype from US that had already been examined by S. Eliasaro & M. Adler (label dated 1997); (4) the isotype from W also developed abundant botryose structures and the upper cortex is injured in some lobes, however the soralia is not so well developed.

Within the additional specimens examined, two of them do not developed the botryose structures (*Spielmann* 1348 and *Spielmann* 1350), being probably young thalli. The latest

(*Spielmann* 1350) also has the apices of some lobes pruinose. The specimen *Spielmann* 4920 is 33 cm long, the larger thallus found.

Distribution: known only for Brazil, being recorded to the States of Paraná, Rio de Janeiro (Kurokawa 1974), Rio Grande do Sul (Fleig 1997, Canêz 2005, Spielmann 2005), Santa Catarina (Fleig 1997) and São Paulo (Fleig 1997, Ribeiro 1998, Benatti 2005).

Additional specimens examined: Brazil, Rio Grande do Sul State, Municipality of Boqueirão do Leão, Linha Sinimbuzinho, Perau da Nega, 29°20′17.2″S, 52°26′33.6″W, 430 m alt., saxicolous, open place, near the waterfall., 23.II.2004, leg. *A.A. Spielmann* & *L.S. Canêz* 1348, 1349, 1350 (SP). The same, Municipality of Santa Cruz do Sul, near the Residencial Costa Norte, 29°41′25.3″S, 52°26′19.3″W, 100 m alt., corticicolous, on forest border, 26.VI.2004, leg. *A.A. Spielmann* 1168, 1171, 1172, 1200 (SP). The same, São Paulo State, Municipality of Mogi-Mirim, Estação Experimental do Instituto Florestal, corticicolous, border of Cerradão vegetation, 14.V.2004, leg. *A.A. Spielmann*, *M.P. Marcelli*, *P. Jungbluth* & *M.N. Benatti* 4920.

***Parmotrema stuppeum* (Taylor) Hale**
Phytologia 28 (4): 339. 1974.

Parmelia stuppea Taylor, London Journal of Botany **6**: 175. 1847. – Type: U.S.A, California, Monterey, leg. *Beechy* [not “Beechey”] (holotype: FH!; isotypes: BM!, K).

(Fig. 72)

Holotype description

Thallus brownish (herbarium), lobate, apparently loosely adnate, 4 cm broad. *Lobes* irregularly branched, crowded, 3–7 mm wide, *surface* extensively cracked; apical zone rounded; margin smooth to dentate, undulated. *Maculae* apparently present in some areas, barely distinct and difficult to interpret because of the thallus state of preservation, maybe punctiform or effigurate. *Cilia* absent? (Only something similar to one cilium was found, black, ca. 0.5 mm, simple). *Lacinules*, *pustules* and *isidia* absent. *Soralia* marginal or extensive; *soredia* farinose. *Undersurface* black and with abundant reddish brown stains, lustrous, strongly venate, naked, with scars; *marginal zone* black or with brown stains, naked, with veined; *rhizines* black, seen only through one hole in the thallus where somebody made a spot test (possibly Hale).

Apothecia plane or more usually concave, up to 7 mm in diameter, short-stipitate, laminal, margin smooth, crenate or with deep incisions, sorediate, amphithecium usually sorediate, disc dark brown, probably paler when freshly collected, epruinose, imperforate, often cracked; *ascospores* not formed or immature. *Pycnidia* absent.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema stuppeum* is recognized by the strictly marginal soralia, absent lacinules, sublageniform conidia and the medium sized ascospores (12–17 × 6–9 µm fide Hale 1965).

It is so very close to *P. cristiferum*, that has larger ascospores (24–35 × 12–20 µm). Another similar species is *P. maximum*, differentiated by the sorediate lacinules.

The holotype of *P. stuppeum* in FH is probably little representative of the species (see Hale 1965) and the same can be said about the isotype from BM. Ascospores and conidial data could not be obtained. On the other hand, the information available about *P. stuppeum* is not conclusive at the present time. Taylor (1847) do not provided microscopic data. The description of Hale (1965) reported ascospores 12–17 × 6–9 µm, episporium 1.0–1.5 µm, and conidia 4–6 µm. However, it is not clear what specimen Hale used to obtain these data, whether from the type of *P. stuppea* or from the type of *P. maxima* (since that was the type illustrated) placed in its synonymy, or from additional specimens examined.

There's a label from Berry (E.C.B), dated from July, 02, 1937, asserting that the specimen in FH could be the type of *Parmelia stuppea*. However, in his publication (Berry 1941) he placed *Parmelia stuppea* as belonging to *Lecanora*.

Some published pictures of *Parmotrema stuppeum*, like that of Hale (1979) and Brodo *et al.* (2001), show the strictly marginal soredia not occurring in lacinules. This concept agrees with Hale (1965: 291), where he clearly stated that *Parmelia stuppea* lacks distinct lacinules (as "laciniae").

Distribution: Africa (Hale 1965), Asia (Divakar & Upreti 2005), Europe (Hale 1965), North America (Hale 1965, Brodo *et al.* 2001) and Central America (Hale 1965).

***Parmotrema subcaperatum* (Kremp.) Hale**
Phytologia 28 (4): 339. 1974.

Parmelia subcaperata Kremp., Videnskabelige meddelelser fra Dansk naturhistoriske Forening i Kjöbenhavn 5: 10. 1874. – Type: Brazil, [Minas Gerais State, Municipality of Caeté], Serra da Piedade, ad truncos arborum, leg. *Warming* 297 (holotype: M!).

≡ *Rimeliella subcaperata* (Kremp.) Kurok., Annals of the Tsukuba Botanical Garden 10: 7. 1991.
≡ *Canomaculina subcaperata* (Kremp.) Elix, Mycotaxon 65: 477. 1997.

= *Parmelia imperforata* Nyl., Acta Societates Scientiarum Fennicae 26 (10): 7. 1899. Type: Brazil, 1871, leg. *Glaziou* 1839 (holotype: H-NYL n° 35425).

(Fig. 73)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, corticicolous, 4 cm broad. *Lobes* irregularly branched, crowded, 3–7 mm wide, *surface* continuous, smooth to subfoveolate, lustrous, becoming rugose, cracked and foveolate towards the center; apical zone rounded; margin crenate to irregular or sublacinulate, plane to undulated. *Maculae* distinct or sometimes weak, effigurate, laminal, originating cracks or not. *Cilia* black, simple and apparently also rarely furcated, up to 1.5 mm long, quite thickened, 0.04–0.10 mm wide, few. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black or brown blackish, opaque, slightly rugose or papillate, with cracks; *marginal zone* dark brown or brown, opaque to lustrous, 3–10 mm wide, naked or rhizinate, with an attenuated limit, smooth to papillate or veined; *rhizines* black, dimorphic, the shorter ones simple, up to 1.0 mm long, thin, 0.02–0.05 mm wide, few, irregularly distributed, the longer ones up to 2 mm long, thickened, 0.05–0.10 mm wide, simple or irregularly branched near the apices, frequent, irregularly distributed.

Apothecia cupuliform, up to 8 mm in diameter, substipitate, laminal or submarginal, margin incised to lacerate, usually involute, amphithecium maculate, strongly rugose and foveolate

when mature, disc dark brown to blackish, epruinose, perforate at maturity; *ascospores* ellipsoid, 14–16 × 9–11 µm, episporium 1.0–1.5 µm. *Pycnidia* submarginal to less frequently laminal, conspicuous, without prominent margin, abundant, ostiole black; *conidia* not found (ca. 30 pycnidia examined).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

HPLC (J.A. Elix, 23.VII.1997, label with the holotype): atranorin (minor), usnic acid (minor), salazinic acid (major), consalazinic acid (trace).

Remarks: *Parmotrema subcaperatum* is characterized by the effigurate maculae, dimorphic rhizines, absence of propagules and the widely black or brown blackish undersurface, with a marginal and narrow dark brown area.

It is related to *P. erubescens*, already considered conspecific (Hale 1965, Winnem 1975, Kurokawa 1991). However, *P. subcaperatum* has the undersurface black in a wide area, usually slightly rugose to veined, the marginal zone being dark brown and the upper surface subfoveolate to foveolate. On the other hand, in *P. erubescens*, the underside is blackish brown only in the very center, smooth to papillate, the marginal area very light brown, and the upper surface only scrobiculate.

The main characters accepted today for the separation of these species are presented in the Table 3.

Some problems still remain and could not be here clarified. The holotype of *P. subcaperatum* is corticicolous and coriaceous, with ascospores 14–16 × 9–11 µm and, although with abundant pycnidia, conidia were not seen. The lectotype of *P. erubescens* is corticicolous, membranaceous, without apothecia but with conidia 8–11 × ca. 1.0 µm. The features of the underside seems to be comparable to the characters listed by Elix (1997) and so we are accepting these species as good taxa, at least up to more material become available for study.

Table 3. Main characters of *P. subcaperatum* and *P. erubescens* (compiled from Elix 1997)

	P. subcaperatum	***P. erubescens***
Substrate	saxicolous or rarely corticicolous	corticicolous
Thallus consistence	membranaceous	coriaceous
Habitat	temperate	subtropical and tropical
Lower surface	black to the margins or marginal zone dark brown, narrow and naked	with a broad and brown marginal zone, papillate or with short, fine rhizines
Fine rhizines	0.5–1.0 mm long	0.05–0.1 mm long
Coarse rhizines	solitary, rare	grouped in the center
Ascospores	12–19 × 6–10 µm	10–12 × 8–10 µm
Conidia	9–14 × 1 µm	10–14 × 1 µm

It must be noted that the holotype of *P. subcaperatum*, although full of apothecia, is devoid of several entire lobes, and some features, like lobe margins, cilia, etc., could not be well evaluated. The rhizines also seem not so clearly dichotomous, probably because the absence of the lobe apices, where they are normally more common.

The holotype of *Parmelia imperforata* is well developed, with ascospores 11–16 × 10–12 µm, episporium ca. 1 µm and conidia 8–10 × ca. 1 µm. The underside is paler that *P. subcaperata*,

and we are accepting it here as synonym with certain reserve, since this feature could not be adequately studied in the holotype of *P. subcaperatum*. Chemically, the presence of usnic acid was not detected, the holotype having atranorin (minor), chloroatranorin (trace), salazinic acid (major) and consalazinic acid (minor).

Distribution: Oceania and South America (Kurokawa 1991). In South America it is known to Argentina (Calvelo & Liberatore 2002), Brazil (Zahlbruckner 1930a, Kurokawa 1991, Marcelli 2008), Paraguay (Osorio 1970), Uruguay (Osorio 1972) and Venezuela (Vareschi 1973). In Brazil it was recorded to the States of Minas Gerais (Kurokawa 1991), Mato Grosso do Sul (Osorio 1992a), Paraná (Osorio 1977b, Kurokawa 1991), Rio de Janeiro (Kurokawa 1991), Rio Grande do Sul (Spielmann 2005, 2006) and São Paulo (Kurokawa 1991, Marcelli & Benatti 2008).

***Parmotrema subisidiosum* (Müll. Arg.) Hale**
Phytologia 28 (4): 339. 1974.

Parmelia cetrata var. *subisidiosa* Müll. Arg., Engler Botanische Jahrbücher 20: 256. 1894. – Type: Africa, Bumba, Usambara, leg. Holst 8772 p.p. (lectotype: G!), fide Hale & Fletcher (1990).

≡ *Parmelia subisidiosa* (Müll. Arg.) Dodge, Annals of the Missouri Botanical Garden 46: 87. 1959.
≡ *Rimelia subisidiosa* (Müll. Arg.) Hale & Fletcher, The Bryologist 93 (1): 29. 1990.

(Fig. 74)

Holotype description

Thallus brownish, lobate, apparently loosely adnate, corticicolous with mosses, 5.5 cm broad. *Lobes* irregularly branched, laterally overlapped , 3–7 mm wide, *surface* continuous or cracked, smooth or irregularly subscrobiculate, lustrous, becoming strongly cracked and irregular towards the center; apical zone rounded; margin smooth to crenate, undulated. *Maculae* distinct, reticular, laminal. *Cilia* simple, short, up to 0.6 mm long, 0.02–0.05 mm wide, few. *Lacinules*, *pustules* and *soredia* absent. *Isidia* concolor with the thallus, apex usually darker, simple to coralloid, 0.1–0.2 × 0.05–0.15 mm, erect, firm, or less frequently flaking off, sometimes ciliate, laminal or marginal. *Medulla* white. *Undersurface* black, lustrous, smooth or slightly rugose, with few cracks; *marginal zone* dark brown, pale brown or variegating these colors, lustrous, 1–2 mm wide, naked, with an attenuated limit, smooth or papillate; *rhizines* black, simple, irregularly branched or squarrose, sometimes with flatted apices, up to 2 mm long, abundant, evenly distributed.

Apothecia absent. *Pycnidia* submarginal, inconspicuous, without prominent margin, rare, ostiole black; *conidia* not found.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema subisidiosum* is characterized by the formation of simple to coralloid isidia, the reticular maculae and the presence of salazinic acid.

Parmotrema lacteum Marcelli & Spielmann, a close species recently described (Marcelli *et al.* 2007), is distinguished by the formation capitate sorediose clusters originating isidioid soredia, and the milky thallus (see comments under this species).

Another species with reticular maculae and isidia is *P. bonplandii*, distinct by the chemistry: norlobaridone and lichexanthone instead salazinic acid (Mata García 1994).

The holotype of *P. subisidiosum* is well-preserved, while glued by the underside to a paper. The observations of this part were made in a free part. Unfortunately, it doesn't have apothecia, and conidia were not found in the rare pycnidia seen.

There's a label from H. des Abbayes (dated from 1958), giving the spot tests and providing a new combination, "*Parmelia subisidiosa* (Müll. Arg.) des Abb. comb. nov.". A second label made by Hale in 1959, gives the combination as "*P. subisidiosa* (Müll. Arg.) Dodge". In fact, Dodge (1959) published the new combination, and apparently, Abbayes did not.

Distribution: Africa (Dodge 1959, Krog & Swinscow 1981, Hale & Fletcher 1990), North America (Moore 1968, Dey 1978, Brodo *et al.* 2001), Central America (Tenorio *et al.* 2002) and Tropical America (Hale & Fletcher 1990), where it was recorded to Brazil (Marcelli 2008), Uruguay (Osorio 1992b) and Venezuela (Feuerer 2008). In Brazil it was reported to the States of Rio Grande do Sul, Santa Catarina (Fleig 1997), São Paulo (Marcelli 1991, Ribeiro 1998, Benatti 2005).

***Parmotrema subsumptum* (Nyl.) Hale**
Mycotaxon 5 (2): 434. 1977.

Parmelia subsumpta Nyl., Flora 52: 117. 1869. – Type: Brazil, Minas Gerais State, corticicolous, leg. *Glaziou* s.n. (holotype: H-NYL n° 35451!)

≡ *Rimeliella subsumpta* (Nyl.) Kurok., Annals of the Tsukuba Botanical Garden 10: 9. 1991.
≡ *Canomaculina subsumpta* (Nyl.) Elix, Mycotaxon 65: 477. 1997.

= *Parmelia urceolata* Eschw. var. *nuda* Müll. Arg., Flora 63: 266. 1880. Type: Brazil, Rio de Janeiro, prope [Municipality of] Petrópolis, leg. *Deventer* 33 (holotype: G).

= *Parmelia hypotropa* var. *imperialis* Hue, Nouvelles Archives du Muséum d'Histoire Naturelle de Paris, ser. 4 (1): 189. 1899. Type: Brazil, corticicolous, 1887, leg. *S.M. Dona Theresa Christina Maria, imperatrix* (holotype: P).
≡ *Parmelia corrugis* (Fr.) Müll. Arg. var. *imperialis* (Hue) Zahlbr., Catalogus lichenum universalis 6: 236. 1930.

= *Parmelia leucoxantha* Müll. Arg. f. *firma* Sambo, Annali di Botanica 22 (1): 18. 1939. Type: Brazil, Rio de Janeiro, Serra dos Órgãos, May 1839, leg. *Casaretto* 2444 (holotype: RO), fide Hale (1965).

(Fig. 75)

Holotype description

Thallus brownish (herbarium), lobate, ± adnate, corticicolous, 8 cm broad. *Lobes* irregularly branched, crowded, usually strongly crisped, 2–10 mm wide, *surface* usually irregularly cracked, smooth or with irregular depressions, lustrous, becoming reticulately cracked towards the center;

apical zone rounded; margin sinuous-incised, usually strongly crisped, sometimes undulated. *Maculae* weak, effigurate, laminal, originating cracks. *Cilia* black, simple, up to 1.5 mm long, 0.02–0.05 mm wide, rare. *Lacinules*, *pustules*, and *isidia* absent. *Soralia* white, growing from the margin of the lobes and becoming extensive towards the undersurface, the sorediate lobe margins becoming revolute and strongly crisped; *soredia* farinose to subgranular. *Medulla* white. *Undersurface* dark brown to brown, blackening only in the very centre, sublustrous, smooth to papillate or slightly veined, with sparse cracks; *marginal zone* absent (brown) or pale brown, then 1–5 mm wide, lustrous, naked or rhizinate, with a sharp limit, smooth to veined or with very slight depressions; *rhizines* black, dimorphic, the shorter ones simple or sometimes squarrose, usually curled, up to 0.5 mm long, thin, 0.01–0.04 mm wide, abundant, evenly distributed; the longer ones up to 3.5 mm long, thickened, 0.05–0.12 mm wide, simple or more commonly irregularly branched, especially near the apex, frequent, distributed in groups.

Apothecia cupuliform, 1.3–3.2 mm in diameter, stipitate, laminal, margin smooth to incised, usually involute, sorediate or not, amphithecium maculate, smooth to irregular, disc pale brown to dark brown, epruinose, perforate; *ascospores* not seen (11–14 × 7–9 µm fide Nylander 1869). *Pycnidia* submarginal, conspicuous, without prominent margin, few, ostiole black; *conidia* not found (ca. 20 pycnidia examined) see comments below under *Parmelia urceolata* var. *nuda*.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema subsumptum* is characterized by the strongly crisped lobes sorediate at the undersurface, the effigurate (although weak) maculae, the dichotomous rhizines and the simple and rare cilia. The ontogeny of the soralia is quite interesting, since they start at the margin and extends backwards on the undersurface, not the upper surface as is common in *Parmotrema*.

In *P. petropoliense*, before thought to be a synonym (Hale 1965), the soralia are formed in the margin or on the upper surface of conspicuous lacinules that form pustuloid structures (i.e., not extensive). Additionally it has abundant, long (up to 3 mm) and usually furcated cilia.

Parmotrema leucosemothetum can be distinguished by the soralia almost exclusively marginal, the strongly maculate upper cortex (with effigurate maculae), the simple, usually thickened and ± tapered cilia, and the distinctly shiny bare marginal zone on the undersurface.

Finally, *P. margaritatum* has the soralia growing subapically in lacinules, the upper surface hypermaculate, and a black undersurface with monomorphic rhizines.

The holotype of *P. subsumpta* seems to have been pressed, as can be seen by the strongly flattened lobes. It has three poor developed apothecia, and one tentative search by ascospores was made in the larger one. However, the hymenium was immature and no ascospores were found. So we have to trust in the measurements given by Nylander. However, he published (Nylander 1869) ascospores with 11–14 × 7–9 µm, although his handwriting on the envelope states "14–16 × 7–9 µm". Hale (1965) found ascospores 12–15 × 7–10 µm. Analyses of more specimens can help to establish the real range of ascospores variation in this species.

The holotype of *Parmelia urceolata* var. *nuda* agrees well with *P. subsumpta*. It is completely eciliate, and the ontogeny of the soralia described for *P. subsumpta* is more evident here. Conidia were found and they are filiform, 7.5–12 × ca. 1.0 µm. The information concerning the collector (Deventer 33) could not be confirmed since there is no label about this. So this datum comes from Hale (1965).

Parmelia hypotropa var. *imperialis* Hue has as holotype three thalli, all of them agreeing with *Parmotrema subsumptum* in the overall morphology, being scarcely ciliate. One thallus has several well developed apothecia, up to 6 mm in diameter, laminal, substipitate to stipitate,

usually strongly maculate and longitudinally rugose, disc perforate, the margin irregularly sorediate, the ascospores (most immature) being 14.0–16.5 × 7–9 µm. It has the undersurface extensively dark brown and black in some areas while in the larger thallus (13 cm broad, lobes 5–18 mm wide) it is entirely brown. Few pycnidia are present is this thallus, but no conidia was found (ca. 20 pycnidia examined). The third thallus seems to be part of the fertile thallus. Hue's (1899) description is a combination of the features from the three thalli. The two smaller thalli are undoubtedly *P. subsumptum*. The larger thallus is maybe a different species.

Finally, the holotype of *Parmelia leucoxantha* f. *firma* is also identical with the holotype of *P. subsumpta*, only the undersurface was not studied in detail since the thallus is strongly attached to a bark.

Distribution: Africa (Hale 1965, Winnem 1975, Krog & Swinscow 1981), Asia (Kurokawa 1991, Kurokawa & Lai 2001, Chen *et al.* 2003, Divakar & Upreti 2005) Oceania (Kurokawa 1991, Elix 1994, Louwhoff & Elix 1999) and Americas (Hale 1965, Kurokawa 1991). In South America it is known for Argentina (Hale 1965, Kurokawa 1991), Brazil (Hue 1899), Uruguay (Osorio 1979, Kurokawa 1991) and Venezuela (Hale 1965). In Brazil was reported to the States of Minas Gerais (Nylander 1869, Hale 1965, Kurokawa 1991, Ribeiro 1998), Paraná (Eliasaro 2001), Rio de Janeiro (Müller Argoviensis 1880, Cengia Sambo 1939c, Kurokawa 1991), Rio Grande do Sul (Spielmann 2006) and São Paulo (Hale 1965, Ribeiro 1998).

***Parmotrema subtinctorium* (Zahlbr.) Hale**
Phytologia 28 (4): 339. 1974.

Parmelia subtinctoria Zahlbr., in Handel-Mazetti, H.: Symbolae sinicae. Botanische Ergebnisse der Expedition der Akademie der Wissenschaften in Wien nach Südwest-China 1914/1918, III, Lichenes. J. Springer, Wien, p. 193. – Type: China, Prov. Yünnan, prope vicum Sanyingpan ad septentr. urbis Yünnanfu, 26° lat., in regione calide temperata, substr. córtice Quercuum, alt. s.m. ca. 2.400 m, 14.III.1914, leg. *Dr. Heinr. Frh. v. Handel-Mazzetti* 5645 (Diar. Nr. 146) (holotype: WU!).

≡ *Rimeliella subtinctoria* (Zahlbr.) Kurok., Annals of the Tsukuba Botanical Garden 10: 10. 1991.
≡ *Canomaculina subtinctoria* (Zahlbr.) Elix, Mycotaxon 65: 477. 1997.

(Fig. 76)

Holotype description

Thallus brownish (herbarium), lobate, loosely adnate, corticicolous, 10 cm broad. *Lobes* irregularly branched, laterally overlapped to crowded, usually strongly curled, 4–12 mm wide, *surface* slightly scrobiculate, becoming strongly cracked in the center; apical zone and margins usually curled down, when visible the apical zone is rounded, and the margin crenate to incised, plane. *Maculae* distinct, effigurate, laminal. *Cilia* black, simple, up to 1 mm long, 0.02–0.05 mm wide, few and usually broke. *Lacinules*, *pustules* and *soredia* absent. *Isidia* concolor with the thallus or little paler, apex dark brown, simple to coralloid, 0.1–1.0 × 0.05–0.2 mm, erect, firm, apex eciliate, laminal. *Medulla* white. *Undersurface* dark brown to black in the central zone, lustrous, slightly rugose or papillate, with scars; *marginal zone* brown to pale brown, lustrous, 2–5 mm wide, naked or with initial rhizines, with an attenuated limit, difficult to distinguish, slightly rugose and papillate, except in some areas where remains smooth; *rhizines* black or dark brown, abundant, dimorphic, the smaller ones simple and usually curled, up to 0.5 × 0.05 mm,

more or less evenly distributed, the larger ones simple to sometimes branched, up to 3.0 × 0.2 mm, distributed in groups.

Apothecia absent (according to Hale 1965, they are rare, with amphithecium isidiate and the disc imperforate; ascospores 8–11 × 5–8 µm). *Pycnidia* submarginal, conspicuous, without prominent margin, few, ostiole black; *conidia* not found (ca. 30 pycnidia examined.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), norlobaridone (minor), loxodin (trace), protocetraric acid (trace).

Remarks: *Parmotrema subtinctorium* is distinguished by the isidiate thallus with effigurate maculae, the undersurface slightly rugose to papillate, the absence of usnic acid and the presence of norlobaridone.

It is morphologically close to *P. neotropicum*, which isidia can become sorediate, the underside is abundantly veined and additionally has usnic acid and lacks norlobaridone.

Kurokawa (1991) reduced *Parmotrema haitiense* (Hale) Hale to the synonymy of *P. subtinctorium*. This species was not studied here, since it lacks salazinic acid, but we agree with Elix (1993) and Fleig (1997) that they are distinct species.

Hale (1965) reported some synonyms to *P. subtinctorium*, but they were still not investigated: *Parmelia virens* Müll. Arg. f. *isidiosa* Müll. Arg., *Parmelia leucosemotheta* Hue f. *isidiata* Hue, *Parmelia velutina* Zahlbr. [non *Parmelia velutina* (Ach.) Wallr.], and *Parmelia protovirens* Gyelnik.

Distribution: Africa (Hale 1965, Winnem 1975, Krog & Swinscow 1981), Asia (Hale 1965, Park 1990, Kurokawa 1991, Kurokawa & Lai 2001, Chen *et al.* 2003, Divakar & Upreti 2005) and Americas (Hale 1965). In South America it is known to Paraguay (Hale 1965). In Brazil it was recorded to the States of Minas Gerais (Ribeiro 1998) and Paraná (Donha 2005).

***Parmotrema ultralucens* (Krog) Hale**
Mycotaxon 1 (2): 108. 1974.

Parmelia ultralucens Krog, The Bryologist 77 (2): 253. 1974. – Type: U.S.A, Georgia, Harris Co., Dowdell's Knob, on rock, 1965, leg. *H.* Krog (holotype: O!; isotypes: BM!, S and US).

≡ *Canomaculina ultralucens* (Krog) Elix & J.B. Chen, Mycotaxon 86: 21. 2003.

= *Parmelia subcrinita* auct., non Nyl.
= *Parmelia monumentalis* Asahina (not validly published, fide Krog 1974, p. 256).

(Fig. 77)

Holotype description

Thallus pale brownish (herbarium), lobate, loosely adnate, saxicolous, 18 cm broad. *Lobes* irregularly branched, laterally overlapped, 3–11 mm wide, *surface* continuous, smooth to irregular, lustrous, sometimes pruinose in the apices, becoming rugose toward the center; apical zone rounded; margin crenate, undulated. *Maculae* weak and inconspicuous, although covering most of the surface, punctiform to effigurate, usually forming a pseudo-reticular pattern. *Cilia* black, simple or cespitose, 0.5–1.0 (–1.3) × 0.02–0.05 mm, abundant. *Isidia* paler or darker than

the cortex, apex strongly dark brown, simple to less frequently branched, sometimes coralloid, up to 0.5 × 0.05–0.10 mm, erect, firm, apex sometimes ciliate laterally, laminal and marginal. *Lacinules*, *soralia*, and *pustules* absent. *Medulla* white. *Undersurface* black, lustrous, smooth to papillate or slightly rugose, with cracks; *marginal zone* dark brown, lustrous, 1.5–4.0 mm wide, naked, with an attenuated limit, smooth to slightly rugose; *rhizines* black, simple or rarely branched, up to 1.5 mm × 0.01–0.10 mm, abundant, evenly distributed.

Apothecia absent (according to Krog 1974, apothecia rare, up to 8 mm in diameter, disc imperforate, ascospores 15–17 × 10–12 µm). *Pycnidia* submarginal, conspicuous, with or without prominent margin, few, ostiole black; *conidia* short filiform, 6–10 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → orange red, C–, KC–, P+ strong yellow, UV+ yellow.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), lichexanthone (minor).

Remarks: *Parmotrema ultralucens* is characterized by the isidiate thallus, the cespitose cilia and the presence of both lichexanthone and salazinic acid in the medulla.

When describing the species, Krog (1974) asserted that it has rare apothecia. However, no apothecia at all were found in the holotype, and she does not indicate from what specimen the apothecia examined belong. The isotype from BM agrees well with the holotype but it also lacks developed apothecia.

Krog (1974) also recorded that Hale (1965) selected as neotype to *Parmelia subcrinita* Nyl. the specimen H-NYL 35472; however, the specimen listed by Hale actually is H-NYL 35479. If they are different species or this was a typographical error remains an open question.

The name *Parmelia subcrinita*, although rejected by Krog (1974) according to the Article 69 of the *Seattle Code* (Stafleu *et al.* 1972), was still not formally proposed for rejection.

Distribution: Africa (Krog 1974, Swinscow & Krog 1988), Asia (Hale 1965, Krog 1974, Kurokawa & Lai 2001, Elix *et al.* 2002, Chen *et al.* 2003), Azores (Hale 1965, Krog 1974), Oceania (Hale 1965, Krog 1974, Elix 1994, Louwhoff & Elix 1999), North America (Hale 1965, Esslinger 2008), Central America (Hale 1965), and South America (Hale 1965, Krog 1974). In South America it was recorded to Brazil, Colombia and Ecuador (Hale 1965). In Brazil it was cited for the States of Minas Gerais (Hale 1965), Rio Grande do Sul (Spielmann 2006), Santa Catarina (Marcelli 1992) and São Paulo (Marcelli 1992, Benatti 2005).

***Parmotrema verrucisetosum* Sipman**

Mycotaxon 44 (1): 8. 1992.

Type: Guyana, Upper Mazaruni district, trail from Kamarang river to Pwipwi mountain, N of Waramadan, rocky savannah, c. 10 Km N of Waramadan, 05°57′N, 60°45′W, alt. ca. 800 m, 28 February 1985, leg. *H. Sipman* & *A. Aptroot* 19478 (holotype: B!).

(Figs. 78-79)

Holotype description

Thallus greenish-gray to whitish-straw towards the centre, lobate, loosely adnate, corticicolous, 3.0–7.3 (–10) cm broad. *Lobes* irregularly branched, laterally overlapped, 2–11 mm wide, *surface* continuous, smooth, reticulately cracked towards the centre, opaque or slightly lustrous in some areas; apical zone rounded; margin crenate, plane or undulate. *Lacinules* absent.

Maculae absent. *Cilia* black, simple, furcated, dichotomous or sometimes cespitose, 0.5–3.5 × ca. 0.05 mm, abundant, present in the margin and on the laminal and marginal warts. *Pustules*, *soredia* and *isidia* absent. *Warts* conical or flatted, 0–2 × 1–4 mm, laminal and marginal, often with one or more cilia. *Medulla* white, slightly orange in some areas, probably due to the decomposition of the salazinic acid. *Undersurface* black, lustrous, often smooth and with many cracks, sometimes rugose or papillate, rarely scrobiculate; *margin* absent, beige or eburneous, lustrous, 1–4 mm wide, naked, limit to attenuate to sharp, smooth, sometimes slightly rugose or with barely distinct depressions; *rhizines* black, cylindrical or rarely flattened in the basal portion, simple, 0.5–3.0 × 0.05–0.2 mm, frequent, distributed in groups.

Apothecia and *pycnidia* unknown.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent A and B: atranorin and salazinic acid (Sipman & van Aubel 1992).

Remarks: *Parmotrema verrucisetosum* is characterized by the presence of (often) ciliate warts, which distinguish it from all other known *Parmotrema*.

The cilia, on sight, seem to have numerous lateral branches (bristles). With more attention, however, one can perceive the bristles are just fungi growing on the cilia, sometimes reaching the thallus surface. Actually, these are anamorphic fungi, *Hyphomycetes* (R.A.P Grandi, pers. comm.). The under cortex presents several cracks, a feature already observed in several other parmotremoid lichens with salazinic acid. Sipman & van Aubel (1992) described this in the protologue.

When comparing the holotype with the protologue, the first item, thallus size, is a little problematic. The holotype is composed by several pieces, one of them well developed. There is no indication if all were part of the same thallus, and even connecting the parts, the total size do not reach 10 cm. In the protologue the size is reported as "up to at least 12 cm". This left us to compare the holotype with the picture in the protologue, in which the lichens seems to be entire. And it really is. However, it is not the picture of the holotype (*Sipman* & *Aptroot* 19478), but an additional specimen studied (*Sipman* 26595, B, VEN), from Venezuela, not Guyana, collected in 1990. The warts detail is also from this specimen.

Distribution: Guyana, Venezuela (Sipman & van Aubel 1992).

Parmotrema warmingii **(Vainio) Spielmann & Marcelli, comb. nov.**

Parmelia warmingii Vainio, Acta Societatis pro Fauna et Flora Fennica 7 (1): 41. 1890. – Type: based on *P. angustata* Kremp. *non* Pers.

≡ *Parmelia angustata* Kremp., Videnskabelige meddelelser fra den Naturhistoriske forening i Kjöbenhavn **5**: 13, 1873. Not *P. angustata* Pers. *in* Gaudichaud-Beaupré, Voyage autour du monde, exécuté sur les corvettes l'Uranie et la Physcienne, sur les ordres du Cap. L. de Freycinet, en 1817-1820, Botanique, p. 195, 1826 [= *Pannoparmelia angustata* (Pers.) Zahlbr., fide Galloway (2007)]. – Type: Brazil, Minas Gerais State, [Municipality of Caeté], Serra da Piedade, leg. Dr. Warming 324 (lectotype: M!; duplicates of the lectotype: C!, W!).

(Fig. 80)

Lectotype description

Thallus dirty beige to blackened (herbarium), laciniate, loosely adnate, saxicolous, 4 cm broad. *Laciniae* dichotomous, crowded, 0.5–2.0 mm wide, *surface* continuous to irregularly scared, smooth, lustrous, becoming irregularly or reticulately cracked towards the center; apical zone usually acute, sometimes truncate; margin smooth, with a conspicuous black line, plane to slightly undulated. *Maculae* extensive (hypermaculate), laminal, not originating cracks. *Cilia* black, simple, up to 2.3 mm long, 0.01–0.05 mm wide, abundant. *Lacinules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, papillate to rugulose, with cracks; *marginal zone* dark brown, lustrous, 0.5–2.5 mm wide, rhizinate, with an attenuated limit, smooth; *rhizines* black, simple, usually entangled, up to 1.5 mm long, usually thin, rarely thickened, 0.01–0.15 mm wide, frequent, distributed in groups.

Apothecia cupuliform, 1.0–2.5 mm in diameter, sessile to substipitate, laminal or submarginal, margin incised, amphithecium maculate, smooth to irregular, disc dark brown, epruinose, imperforate; *ascospores* ellipsoid, 15–16 × 6–8 µm, episporium 1.0–1.5 µm. *Pycnidia* laminal, conspicuous, without prominent margin, abundant, ostiole black; *conidia* short-filiform, 6.5–10 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

Chemistry: atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor).

Remarks: *Parmotrema warmingii* is characterized by the laciniate thallus with long cilia (up to 2.3 mm) and the hypermaculate upper surface.

It resembles *P. herrei*, a species here recognized and that can be differentiated by the branched, thickened cilia and the reticulate maculate upper surface (not hypermaculate).

Another interesting feature of this lichen is the laminal distribution of the pycnidia. They are almost universally submarginal in the other species of *Parmotrema* s.l. with salazinic acid.

The name *Parmelia angustata* (Krempelhuber 1873) is illegitimate, since is antedated by *Parmelia angustata* Persoon (*in* Gaudichaud-Beaupré1826) that is now *Pannoparmelia angustata* (Pers.) Zahlbr. (Galloway 2007). Vainio (1890), aware of this situation, proposed the new name *Parmelia warmingii* Vainio to the taxon he recognized as good. This name was then used by Zahlbruckner (1902, 1909) to Brazilian lichens he studied, and was also listed in the *Catalogus lichenum universalis* (Zahlbruckner 1930a).

Although Krempelhuber, Vainio and Zahlbruckner recognized this species, it was included by Hale & Fletcher (1990) as a synonym of *Rimelia cetrata*, based on a too wide species concept that included several taxa. *Parmotrema cetratum* (lectotype: H-NYL!) is represented by a laciniate thallus with distinct reticular maculae (not hypermaculate) and with shorter cilia, up to 1.3 mm long.

The lectotype of *P. warmingii* (M) is well-preserved and agreeing totally with the duplicates of the lectotype from C and W, all being probably part of the same collection. The W duplicate has the more developed apothecia, one of them perforate. One specimen studied by Vainio (Lichenes brasiliensis exsiccati 1164, M) also has an imperforate apothecium. Therefore, the perforation seems to occur only in well-developed old apothecia.

Recent collections represented by more developed thalli (up to 10 cm broad) support the differential features of *P. warmingii*, mainly the laciniate thallus with long cilia, the hypermaculate upper surface and the well developed black marginal line in the laciniae. Some specimens has little wider laciniae, like *Canêz* 2464 (up to 3.5 mm wide). The specimen *Spielmann* 2044 has well developed perforate apothecia.

This species is known to Minas Gerais and São Paulo States in Brazil, restricted to highlands (above 1200 m). However it is possible that it occurs in a wider area, since it could be named as *P. cetratum* up to now.

Distribution: Brazil, Minas Gerais State (Krempelhuber 1873, Vainio 1890, Zahlbruckner 1902, Hale & Fletcher 1990).

Additional specimens examined: Brazil, Minas Gerais State, [Municipality of Catas Altas], Caraça, 1885, Vainio Lichenes brasiliensis exsiccati 1164 (M). Idem, at “Cascudos”, 20°05′38.7″S, 43°30′00.3″W, 1300 m, saxicolous, at the margin of the stream, partial sun, 27.III.2006, *A.A. Spielmann*, *L.S. Canêz* & *M.P. Marcelli* 2009, 2017 (SP). Idem, at “Trilha para Capelinha”, 20°05′47.6″S,43°29′06.4″W, 1340m, saxicolous, shaded by a tree, *A.A. Spielmann*, *L.S. Canêz* & *M.P. Marcelli* 2044 (SP), *L.S. Canêz*, *A.A. Spielmann* & *M.P. Marcelli* 1550 (SP), .Idem, at “Tanque Grande”, 20°06′10.1″S, 43°29′38.4″W, 1275 m, saxicolous, slightly shaded, 04.IV.2006, *A.A. Spielmann*, *L.S. Canêz* & *M.P. Marcelli* 2171 (SP). Brazil, São Paulo State, Municipality of Piquete, Pico dos Marins, next to the first massif, 22°30′30.8″S, 45°07′46.4″W, 1.900 m, saxicolous, open place, 27.I.2007, *L.S. Canêz*, *D.F. Peralta*, *J. Bordin* & *J. Atwood* 2464 (SP).

Nomina inquirenda

***Parmelia badia* Pers.**
in Gaudichaud-Beaupré, Voyage autour du monde, exécuté sur les corvettes l'Uranie et la Physcienne, sur les ordres du Cap. L. de Freycinet, en 1817-1820, Botanique, p. 198. 1826. – Type: Hawaiian Islands, *Gaudichaud* 78 (lectotype: PC!; duplicates of the lectotype: BM, G).

(Fig. 81)

However well preserved and not small, the lectotype (PC) is represented by a possibly burnt ill prepared thallus (like *Parmelia maura*, se below), without apothecia or pycnidia. It has very similar sorediate lobes to *P. cristiferum*, and the chemistry needs to be revisited. If it proves to have salazinic acid, the name *P. badia* takes precedence over *Parmelia cristifera*.

In the sheet of the lectotype of *P. badium* (P) there is a label indicating the number 79 and "*Parmelia flexuosa* Delise, *P. badia* Pers.". The name *P. flexuosa* was not found in any catalogue (Zahlbruckner1934, Lamb 1963, Index Fungorum 2009) and was possibly never published.

***Parmelia cetrata* Ach. f. *sorediifera* Vainio**
Acta Societatis pro Fauna et Flora Fennica 7 (1): 40. 1890. – Type: BRAZIL, Minas Gerais State, Sitio [now Antonio Carlos Municipality], leg. Vainio, Lichenes Brasilienses Exsiccati 616 (lectotype: TUR!).

This taxon is represented by a small (2.5 cm broad) not well developed thallus without apothecia and pycnidia growing with a fertile *Hypotrachyna* (Vainio) Hale. It has short open lacinules, sorediate at the apices. The soralia also develop submarginally, turning the lobes concave. This is the pattern we found in many Brazilian specimens we named previously *Parmotrema clavuliferum* (Spielmann 2005, Benatti 2005, Jungbluth 2006) and, in respect with the submarginal soralia and short, open lacinules, they are clearly different from the type of *Parmelia clavulifera*. Conidial and ascospores features could not be studied to clarify the status of this taxon.

***Parmelia cinerascens* var. *saxicola* Räs.**
Suom. Eläin.Kasv. Seuran Vanamo 2: 45. 1947. – Type: Uruguay, Pan de Azucar, Maldonado, *Lamb* (lectotype: H), fide Hale & Fletcher (1990).

The type was not sent by H. This taxon was listed as synonym of *P. cetratum* by Hale & Fletcher (1990).

Parmelia cristifera* Taylor f. *cinerata Zahlbr.
Repertorium species novarum Fedde 33: 58. 1934. – Type: Formosa, Kuwarus, leg. *Asahina* 51 (holotype: W; isotype: BPI), fide Hale (1965).

The holotype was not sent by W and BPI could not be contacted.

Parmelia gossweileri C.W. Dodge
Annals of the Missouri Botanical Garden 46: 153. 1959. – Type: Angola, Chiloango, leg. *Gossweiler* 8091e (holotype: K), fide Hale (1965).

The holotype could not be found in K.

Parmelia imerinensis C.W. Dodge
Annals of the Missouri Botanical Garden 46: 143. 1959. – Type: Madagascar, East Imerina, leg. *Hildebrandt* (holotype: FH!).

Holotype description

Thallus beige (herbarium), probably greenish-gray when fresh, lobate, loosely adnate, corticicolous, 16 cm broad. *Lobes* irregularly branched, laterally overlapped, 5–13 mm wide., *surface* usually smooth, lustrous, extensively damaged and finely rugose; apical zone rounded; margin smooth or crenate, undulated. *Cilia* absent (three small formations seen, but probably rhizines). *Lacinules*, *maculae*, *isidia* and *pustules* absent. *Soralia* concolor to the thallus or whitish, usually linear and marginal, less frequently capitate and growing in the lobe crests; *soredia* granular. *Medulla* white. *Undersurface* black, lustrous, smooth or slightly rugose, with scars; *marginal zone* brown, lustrous, up to 6 mm wide, naked, with an attenuated limit, smooth, rugose or papillate; *rhizines* black, simple (few observed).
Apothecia and *pycnidia* absent.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C, HPLC (J.A. Elix, 03.XI.1998): atranorin (minor), chloroatranorin (trace), salazinic acid (major), consalazinic acid (minor), methyl pseudosalazinate, unknowns (minor/trace).

Remarks: *Parmelia imerinensis* was proposed by Dodge (1959) based on a peculiar cortical structure. The holotype is represented by a thallus with the upper cortex extensively damaged, eroded, that give it an appearance of finely rugose/granulose. In one area, the surface seems maculated, but has no maculae in the rest.

At present time is difficult to compare anatomical information relating *Parmeliaceae*, since very few investigations are available. Recent discoveries (Barbosa 2009) show that cortical anatomy could be quite a powerful tool to taxonomy.

Since apothecia and pycnidia were not found, the status of *P. imerinensis* remains unclear. There is a chemical difference between *P. imerinensis* and *P. cristifera*, since the last contains eumitrins. Morphologically, there are much more laminal soralia in *P. imerinensis*, and the marginal ones are not as crisped as in *P. cristifera*. On the other hand, cilia are absent, making this species not conspecific with *P. sieberi*.

The holotype is glued by the underside, so the observations were limited to the free margins.

One of the specimens determined by Dodge (label dated 1957), is clearly another species, since it do not has salazinic acid (medulla K+ slowly yellowish), but probably protocetraric acid (Hildur Krog's label, TLC, 19..). Actually, this is the holotype of *Parmelia paxinoides* C.W. Dodge (see Dodge 1959). The data from the protologue agree very well with the specimen.

Parmelia maura **Pers.**
in Gaudichaud-Beaupré, Voyage autour du monde, exécuté sur les corvettes l'Uranie et la Physcienne, sur les ordres du Cap. L. de Freycinet, en 1817-1820, Botanique, p. 198. 1826. – Type: Hawaiian Islands, *Gaudichaud* (lectotype: L!; duplicate of the lectotype: H-NYL!).

The lectotype (L), collected in the Hawaiian Islands, is represented by an apparently burnt thallus. It contains only atranorin [minor] and chloroatranorin [major] (TLC in solvent C, HPLC – J.A. Elix, May 2009). The ascospores are ellipsoid, 16–20 × 10–12 µm, episporium 1.0–1.5 µm. Conidia were not found in this specimen, but the duplicate of the lectotype (H-NYL 35280!) revealed conidia filiform, 12–16.5 × ca. 1 µm. These features exclude this taxon as synonym of *Parmotrema cetratum* (Hale & Fletcher 1990), especially the absence of salazinic acid. Otherwise it can be close to *P. macrocarpum* (Pers.) Hale (see also Hale & Fletcher 1990). However, studies on the type of this species and its synonym *Parmelia macrocarpoides* Vainio were not performed yet.

Parmelia menziesii **C.W. Dodge**
Annals of the Missouri Botanical Garden 46: 101. 1959. – Type: Cape of Good Hope, *Menzies* s.n. (holotype: FH-Tuck!). Not *Parmelia menziesii* Ach., Meth. Lich. 221. 1803 (= *Leptogium*).

The holotype (FH), from Cape of Good Hope, presents apothecia 1–4 mm in diameter that are concave or urceolate, stipitate, laminal, with maculate amphithecium, disc brown, epruinose, imperforate, and immature ascospores ellipsoid 15–18 × 10 µm, with episporium ca. 2 µm. The pycnidia are submarginal, conspicuous, without prominent margin, frequent, ostiole black, conidia filiform, 12–16 × ca. 1.0 µm. The cortex is K+ yellow, UV–, and the medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–, so attesting the presence of salazinic acid.

The more salient difference of this species is supposedly conidial, but the observations we made do not match with the protologue (conidia bacillary, 5–6 × 1 µm, fide Dodge 1959). The remaining of the morphology is difficult to evaluate due to the very fragmentary status of the type, devoid of well developed apothecia, etc. Actually, there are only three parts from one (or more) thallus glued in a paper and only immature ascospores were found in the larger apothecium. They revealed similar measures as described by Dodge (1959).

Hale & Fletcher (1990) listed this species as a synonym of *Parmotrema cetratum*. However, attention should be placed in the imperforate apothecia, since in *Parmotrema cetratum* they are clearly perforate. It is possible they are so because immature, and so it seems convenient to maintain *P. menziesii* as a *nomen inquirendum* until more specimens from the type locality be studied.

***Parmotrema moreliense* (B. de Lesd.) W.L. Culb. & C.F. Culb.**
The Bryologist 84 (3): 310. 1981.

Parmelia moreliensis B. de Lesd., *Lichens du Mexique*: 5. 1914. – Type: Mexico, Etat de Michoacan. Morelia; Campanario No 4400 sur écorce (Bouly de Lesdain 1914).

≡ *Everniastrum moreliense* (B. de Lesd.) Hale, *Mycotaxon* **3** (3): 348. 1976.

This type was not located, since the information about the type and where it is located was not supplied by Bouly de Lesdain (1914), Culberson & Culberson (1981) and Hale (1976).

***Parmelia perforata* var. *microspora* Räs.**
Suom. Eläin.Kasv. Seuran Vanamo 2: 45. 1947. – Type: Argentina, Tucumán, San Xavier, *Herrera* 2519 (lectotype: H), fide Hale & Fletcher (1990).

The type could not be found in H. This taxon was listed as synonym of *P. cetratum* by Hale & Fletcher (1990).

***Lichen perlatus* α *ciliatus* Lam. & DC.**
Flore Française 2: 403. 1805.– Type: France, Vire, leg. *Delise* s.n. (lectotype: G, fide Hale & Fletcher 1990).

≡ *Parmelia perlata* g *ciliata* (Lam. & DC) Duby, *Bot. Gall.* **2**: 601. 1830.
≡ *Parmelia perlata* var. *tentaculata* Wallr., *Fl. Crypt. Germ.* **3**: 521. 1831. Based on *Lichen perlatus* α *ciliatus*.
≡ *Parmelia ciliata* (Lam. & DC) Nyl., *Flora* **61**: 247. 1878.
≡ *Parmelia perlata* var. *ciliata* (Lam. & DC) Jatta, *Fl. Ital. Crypt.* **3**: 206. 1909.
≡ *Parmelia ciliata* (Lam. & DC) Fink, *Proc. Indiana Acad. Sci.* 1918: 268. 1919. Superfluous combination, fide Hale & Fletcher (1990).
≡ *Lobaria perlata* [beta] *ciliata* Lam. & DC, fide B. Hale & DePriest (1999).

The lectotype of this species was not found in G. However, the curator (Philippe Clerc) kindly sent one specimen labeled *Parmelia perlata* var. *ciliata* Delise from Vire. This is a well-developed lichen with ciliate isidia and stictic acid (medulla K+ yellow, P+ orange). The real identity is beyond the scope of the present work, but it is probably *Parmotrema crinitum* (Ach.) M. Choisy.

Since there are no annotations from Hale (or anyone) with the specimen and it clearly do not belong to *Parmotrema reticulatum*, the name *Lichen perlatus* α *ciliatus* remains to be clarified in the future.

***Parmelia polita* Fr.**
Syst. Orb. Veg. 1: 283. 1825. – Type: U.S.A., North Carolina, *Schwinitz* (lectotype: UPS). “As Müller Argoviensis (Flora 70: 318. 1887) noted, the published locality (Cape, South Africa) cited by Fries is incorrect”, fide Hale & Fletcher (1990).

The type was not sent by UPS. This taxon was listed as synonym of *P. cetratum* by Hale & Fletcher (1990).

Excluded name

Parmelinella afrocetrata (Elix, Fischer & Killmann) Marcelli & Spielmann, comb. nov.

Parmotrema afrocetratum Elix, Fischer & Killmann, The Lichenologist 37 (2): 103. 2005. – Type: Rwanda, Butare, park of the Institut de Recherche Scientifique et Technologique, c. 1750 m alt., on rocks, 14.X.1999, E. Fischer, s.n. (holotype: B!; isotype: CANB).

(Fig. 82)

Holotype description

Thallus yellowish gray, lobate, loosely adnate, over rocks with debris, 8 cm broad. *Lobes* irregularly branched, crowded, 4–8.5 mm wide, *surface* continuous or irregularly cracked, smooth, lustrous or opaque, becoming reticulate cracked towards the center; apical zone rounded; margin smooth to crenate or irregular, undulated. *Maculae* weak or indistinct, irregular, laminal. *Cilia* simple, rare in the axils, very small, up to 0.1× 0.02 mm. *Lacinules*, *pustules*, *soredia* and *isidia* absent. *Medulla* white. *Undersurface* black, lustrous, papillate or rugose, with cracks; *marginal zone* brown, lustrous, 2–4 mm wide, rhizinate, with an attenuated limit, rugose or papillate, or rarely with veins; *rhizines* concolor to the undersurface, simple or rarely branched, frequently with penicillate whitish apices when in the marginal zone, short and thin, up to 0.5 mm long, 0.01–0.04 mm wide, abundant, evenly distributed.

Apothecia cupuliform, 0.5–2.0 mm in diameter, stipitate, laminal, margin smooth or sometimes with a profound incision, amphithecium smooth, disc brown, epruinose, imperforate; *ascospores* ellipsoid, 8.5–9.0 × 6.0–6.5 µm, episporium 0.5–1.0 µm. *Pycnidia* laminal, conspicuous, usually with prominent margin, abundant, ostiole black; *conidia* sublageniform, 5.0–7.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → blood red, C–, KC–, P+ strong yellow, UV–.

TLC in solvent C (J.A. Elix, 21.X.2003, label with the holotype): atranorin (minor), salazinic acid (major), consalazinic acid (minor).

Remarks: the rarely ciliate (only in the axils) lobes, apothecia imperforate, small ascospores, conidia sublageniform, medulla with salazinic and consalazinic acid and overall morphology, including the rhizines that develop a penicillate whitish apex when growing near the marginal zone, are an indicative that this species do not belong to *Parmotrema*, being more adequately treated under *Parmelinella* Elix & Hale.

Benatti & Marcelli (2007) provided a worldwide key to this genus, and two species with brown marginal zone could be compared with: *P. manipurenses* (Singh) Elix & Hale is the only known saxicolous species, has larger ascospores 9–14 µm and smaller conidia 2–4 µm (Singh 1980), while the corticolous *P. simplicior* (Hale) Hale & Elix has smaller ascospores 6 × 4 µm and also shorter conidia 2–3 µm (Hale 1972).

This seems the first species in *Parmelinella* with sublageniform conidia.

Although in the protologue the substrate was described as saxicolous, the holotype has several wood pieces in the underside, as well mosses and soil. This can indicate the thallus was growing on debris on rocks.

Distribution: Africa –Rwanda (Elix *et al.* 2005, Bock *et al.* 2007).

Final remarks

The present study of *Parmotrema* s.l. with salazinic acid resulted in the full type descriptions and comments on 61 species, two of them new species and 15 new combinations (01 in *Parmelinella*).

This shows that the species concept as used nowadays in this group is clearly unsatisfactory, several good species being recognized as synonyms of few species, said "very variable" and "widely distributed" in the literature.

Therefore, some important conclusions are:

- maculae, cilia, type and development of soredia and isidia and conidial features constitute, in *Parmotrema* with salazinic acid, good specific characters;
- *arbuscula* were considered structures distinct from isidia;
- distinction was made between reticular maculae, pseudoreticular maculae and hypermaculate thalli;
- although with recognized importance in the taxonomy of lichenized fungi, conidial features were usually overlooked in the literature, about 40% of the present conidial information being described for the first time;
- undersurface features, like brightness, relief and type of rhizines are more important that previously thought;
- the number of accepted synonyms, especially in tropical species, is very high. However, when original descriptions are compared, the species seem different; when the types are compared, there are no doubts that several taxa constitute good species.

The characters and methodology employed seem also applicable to the *Parmotrema* without salazinic acid – a good way to test the several statements made here. Only then, some subgeneric rearrangements or more general conclusions could be established. Anyway, *Parmotrema* undoubtedly is a very diverse genus, and a new taxonomical approach is necessary, especially in the neotropical species.

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Figures 1-2: 1 – Holotype of *Parmotrema acanthifolium* (P); **2** – Part of the holotype of *P. albinatum* (TNS). Scales in millimeters.

Figures 3-4: 3 – Part of the holotype of *Parmotrema albinatum* (TNS), underside; **4** – Holotype of *P. austrocetratum* (CHR). Scales in millimeters.

Figures 5-6: 5 – Holotype of *Parmotrema austrocetratum* (CHR), upper surface with schizidia; **6** – Holotype of *P. austromaculatum* (SP). Scales in millimeters.

Figures 7-9: **7** – Holotype of *Parmotrema bifidum* (S); **8** – Holotype of *P. bifidum*, undersurface; **9** – Holotype of *P. bifidum*, furcated cilia. Scales in millimeters, except as indicated.

1 mm

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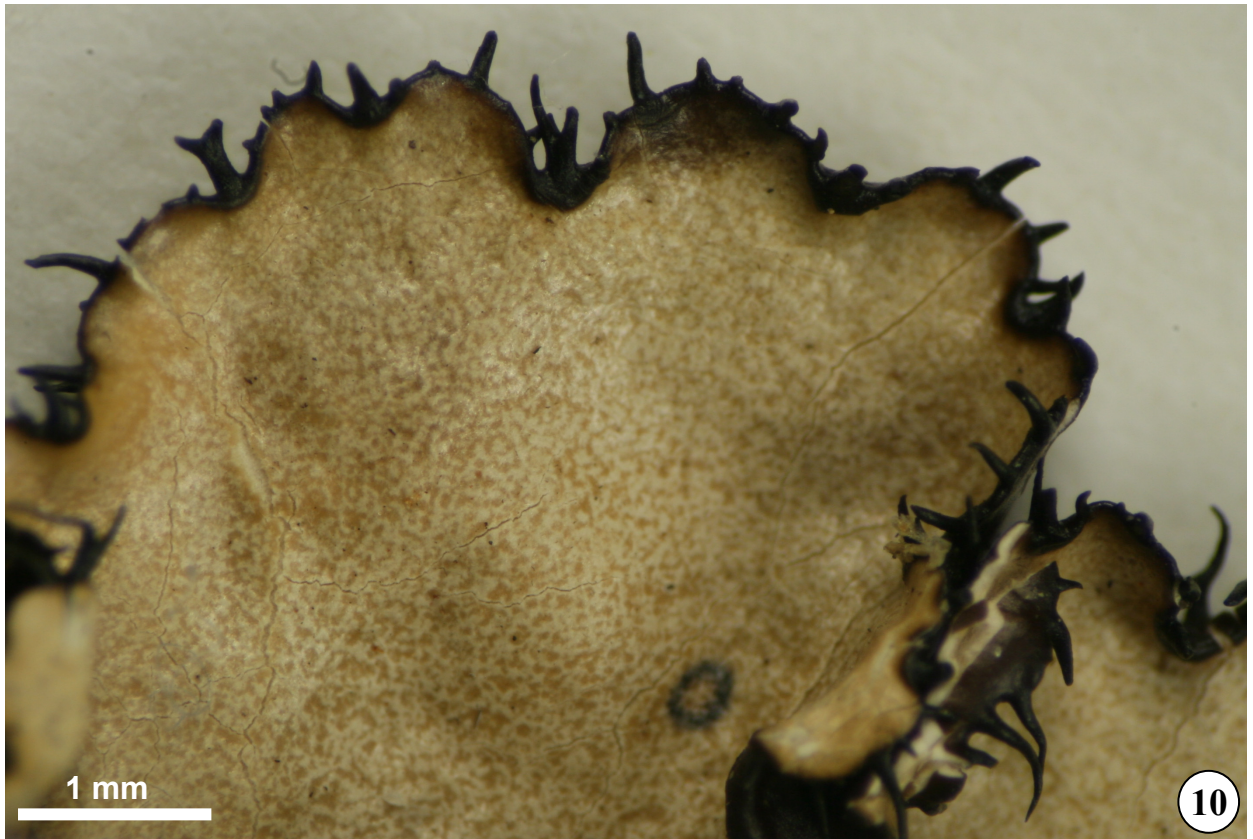
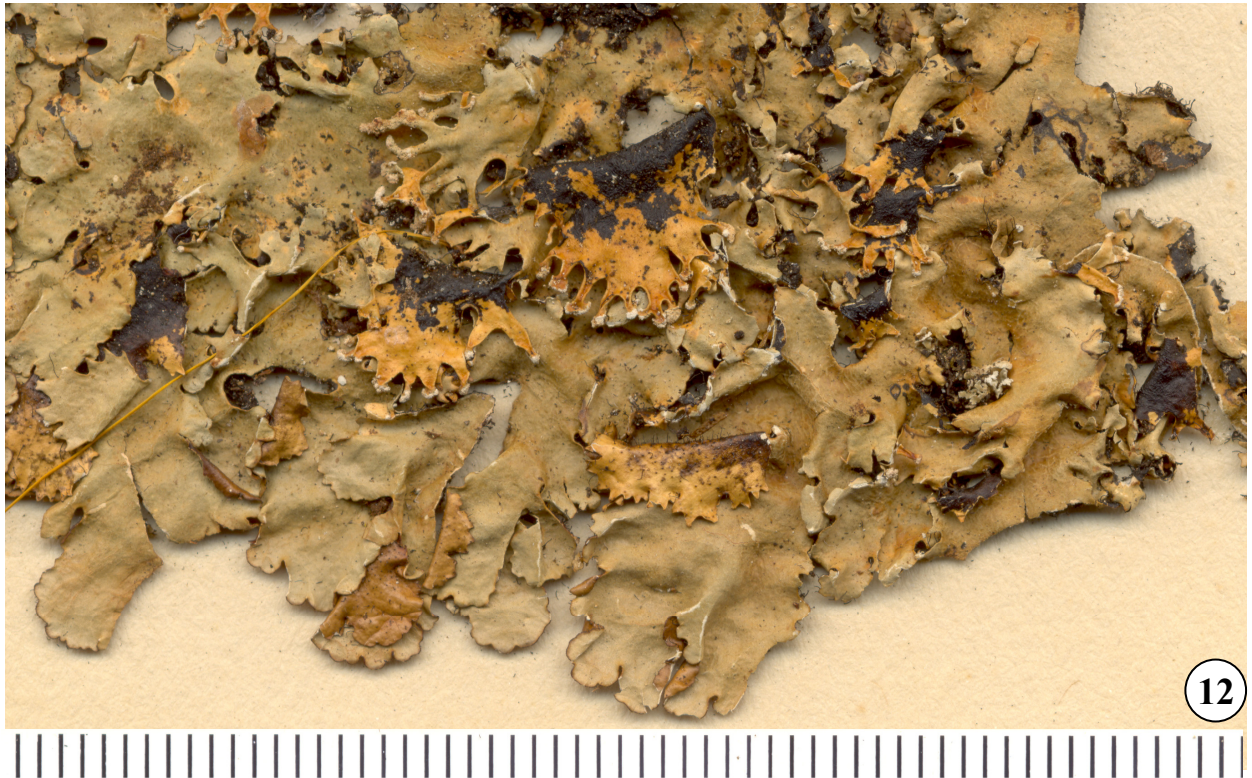
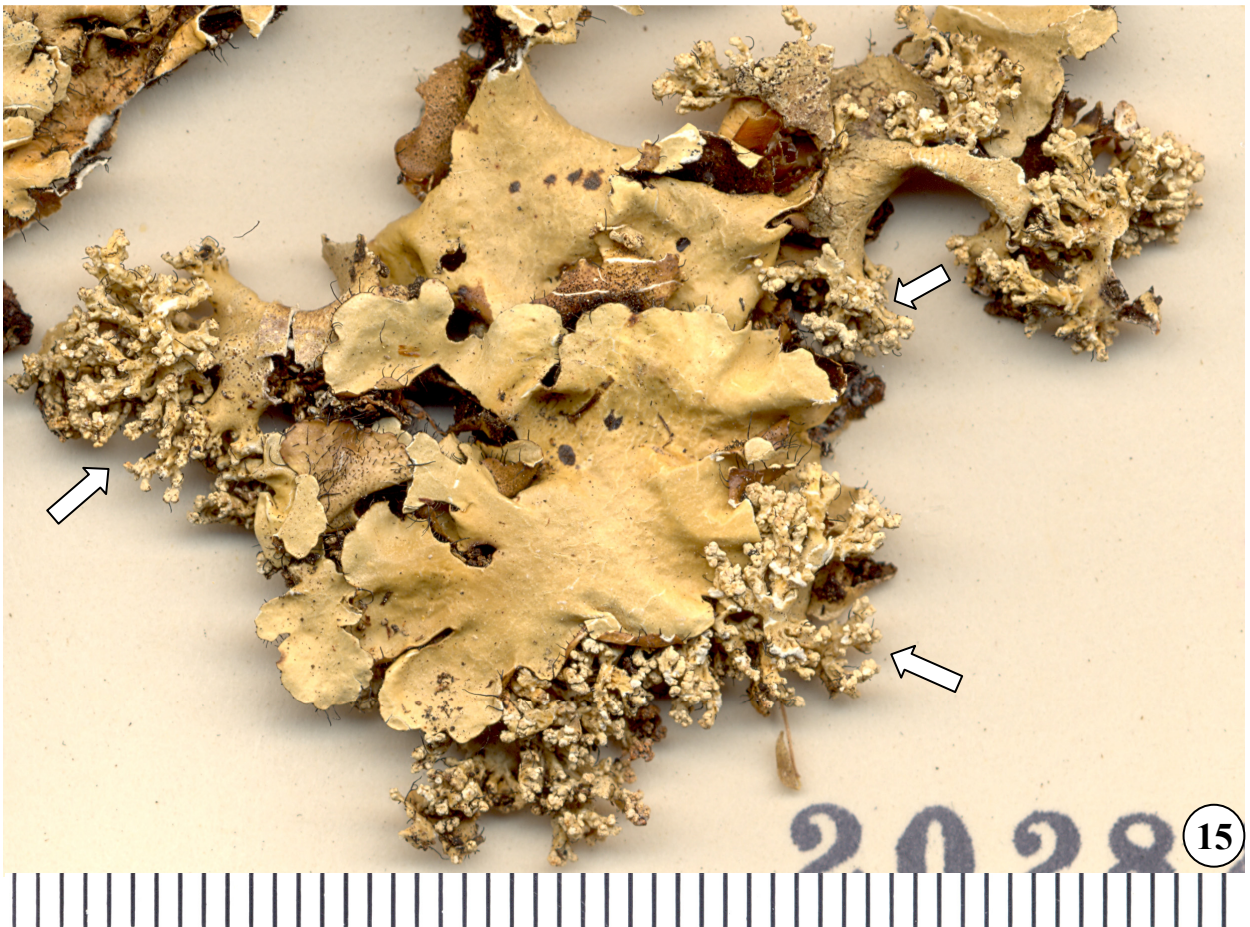
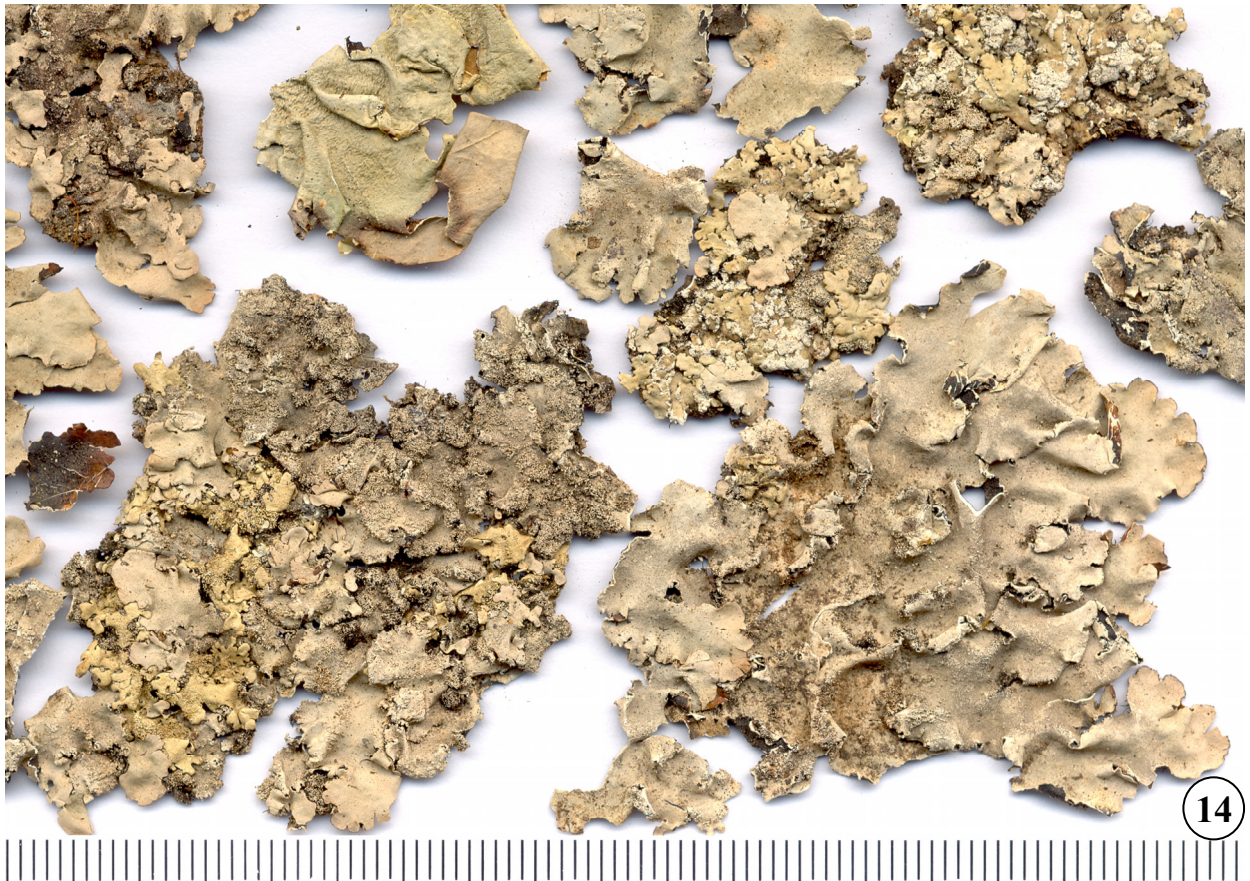
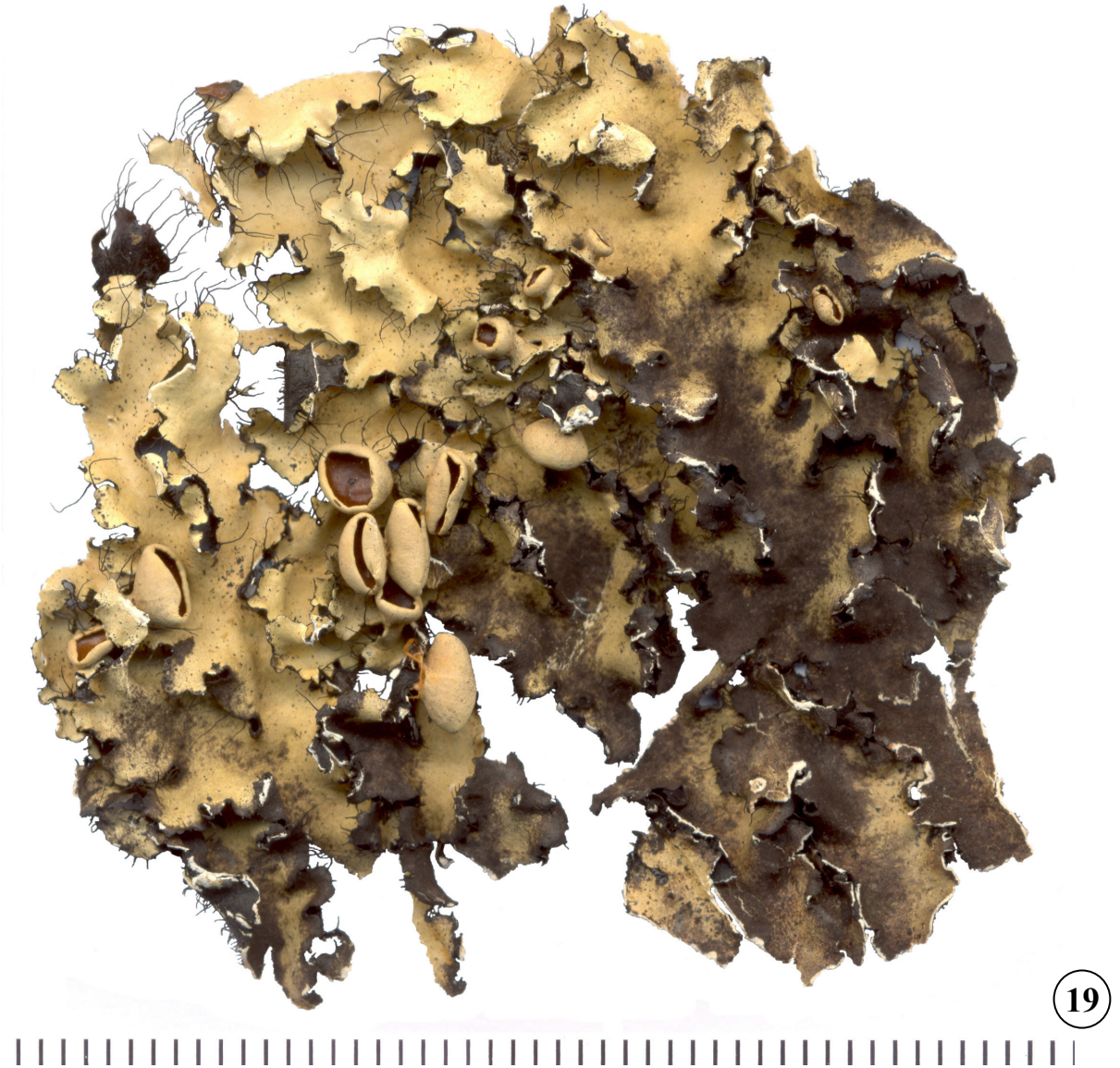

Figures 10-11: 10 – Holotype of *Parmotrema bifidum* (S), upper surface with strong effigurate maculae; **11** – Lectotype of *P. cetratum* (H-ACH). Scales in millimeters, except as indicated.

Figures 12-13: 12 – Part of the lectotype of *Parmotrema clavuliferum* (H); **13** – Lectotype of *P. concors* (M). Scales in millimeters.

Figures 14-15: 14 – Part of the holotype of *Parmotrema concurrens* (US); **15** – Part of the holotype of *P. coralliforme* (US), showing arbuscular structures (arrows). Scales in millimeters.

Figures 16-17: 16 – Lectotype of *Parmotrema cristiferum* (FH); **17** – Holotype of *Parmelia mesotropa* f. *sorediosa* (G). Scales in millimeters.

Figures 18-19: 18 – Holotype of *Parmotrema cristobaliae* (CTES); **19** – Holotype of *P. delicatulum* (TUR-V). Scales in millimeters.

Figures 20-21: 20 – Part of the isotype of *Parmotrema elixii* (CANB); **21** – Isotype of *P. enteroxanthum* (UPS). Scales in millimeters.

Figure 22: Lectotype of *Parmotrema erubescens* (BM). Scale as indicated.

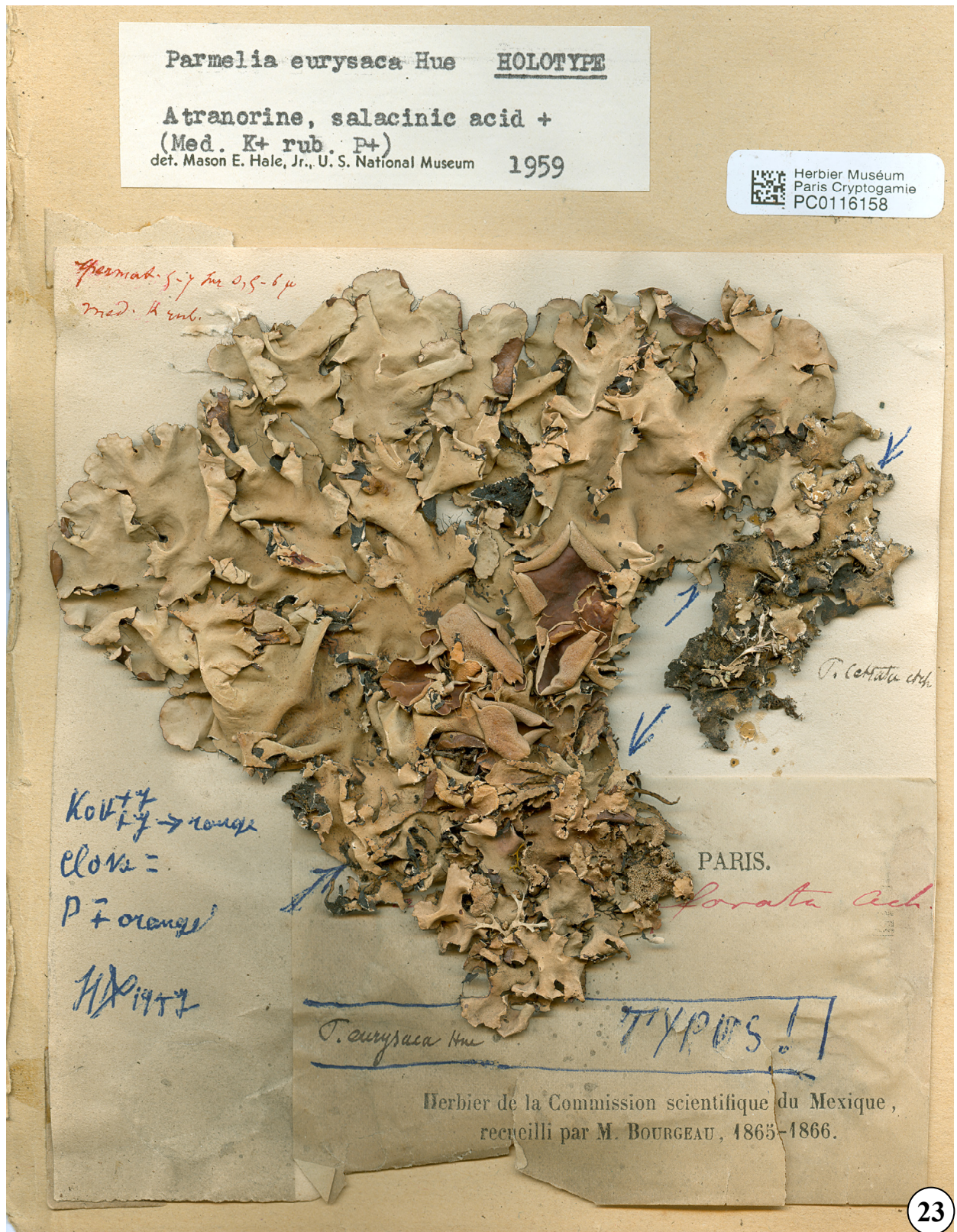



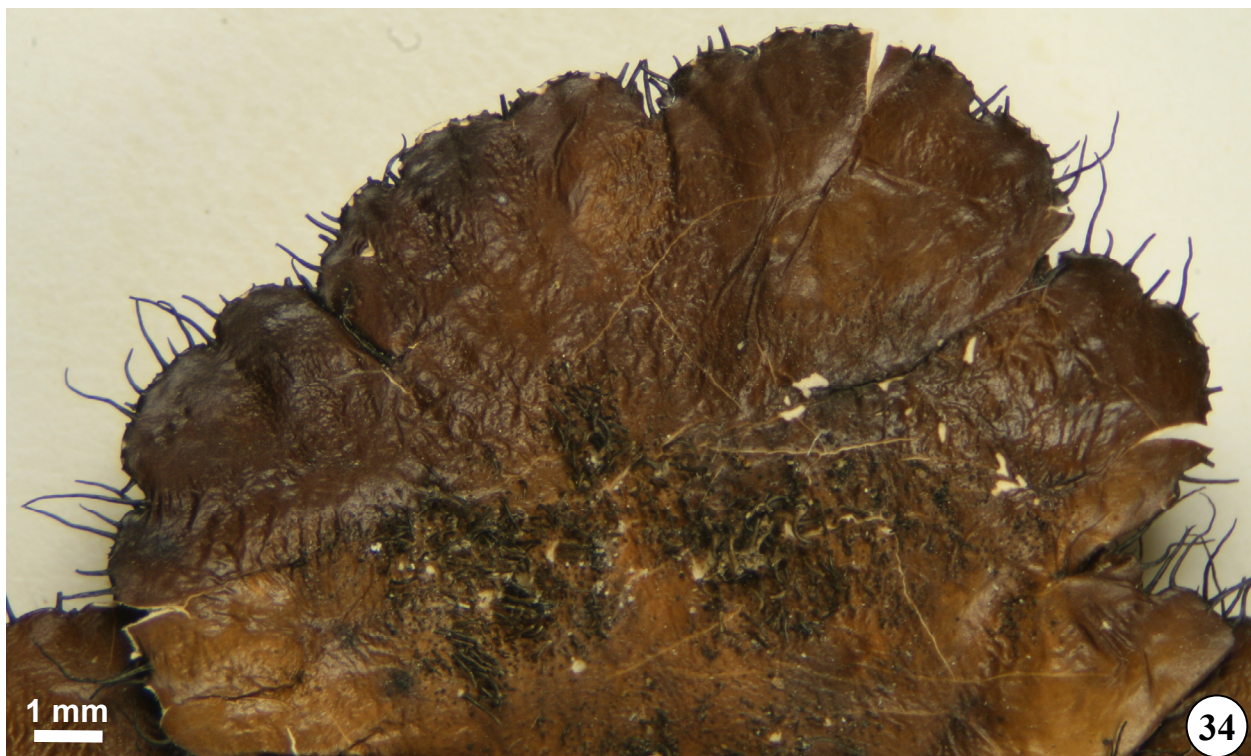
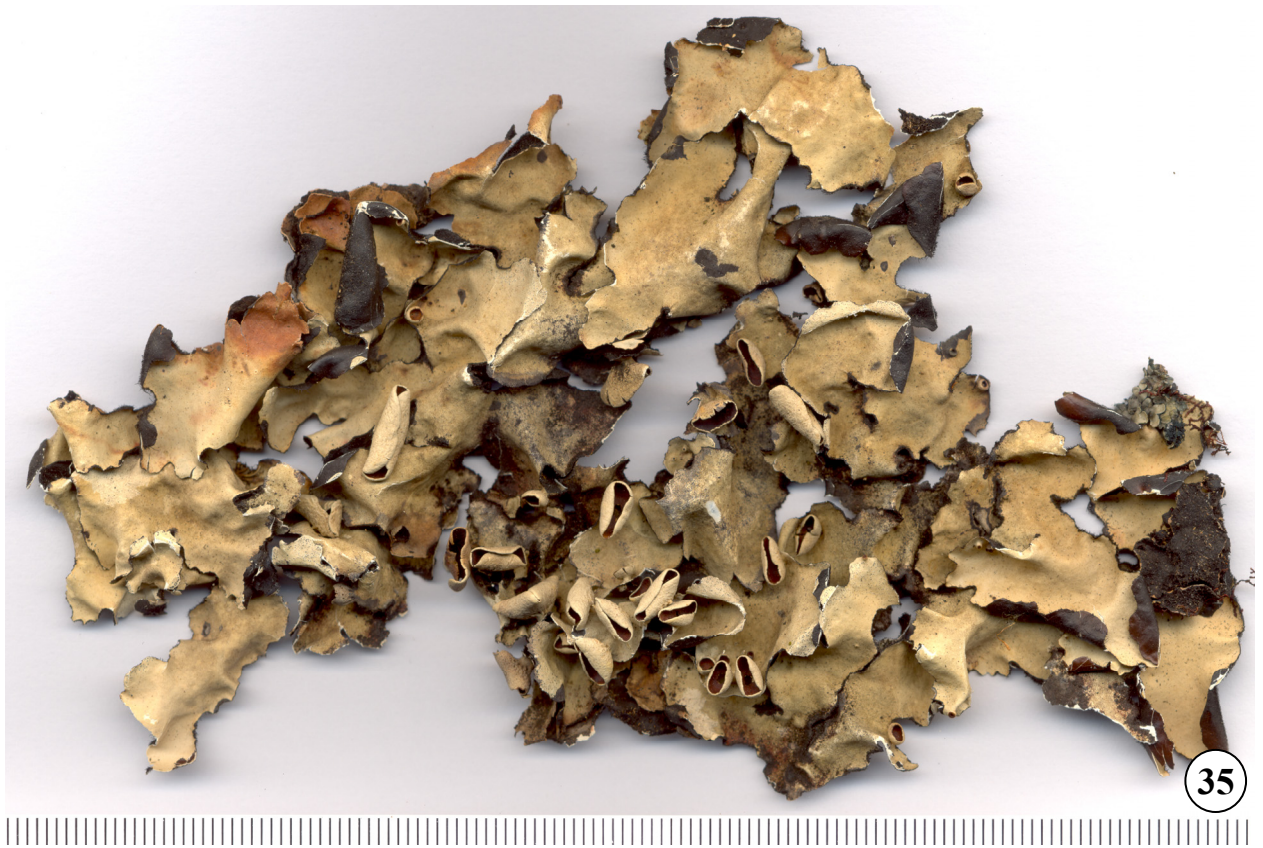
Figure 23: Holotype of *Parmotrema eurysacum* (P). Scale in millimeters.

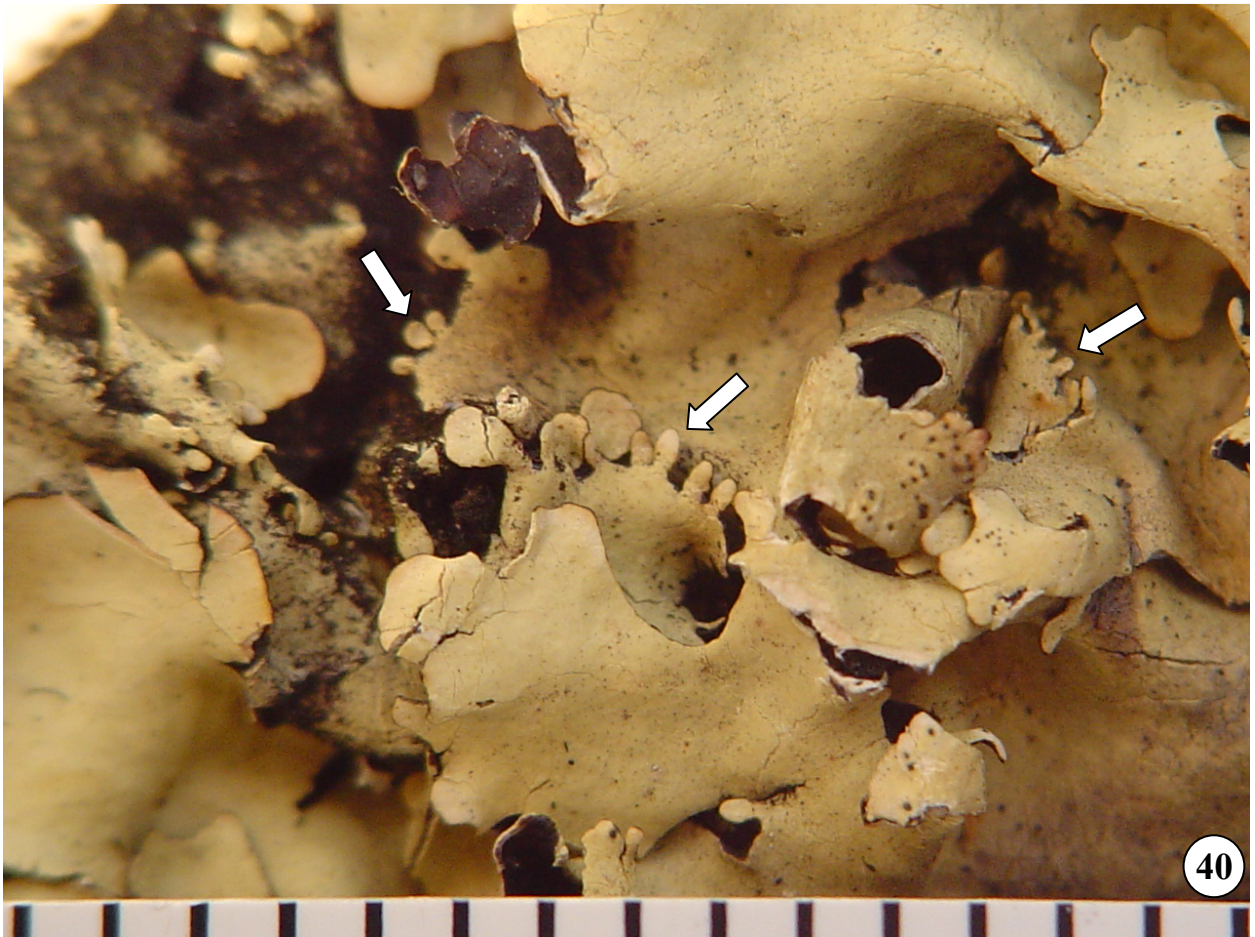
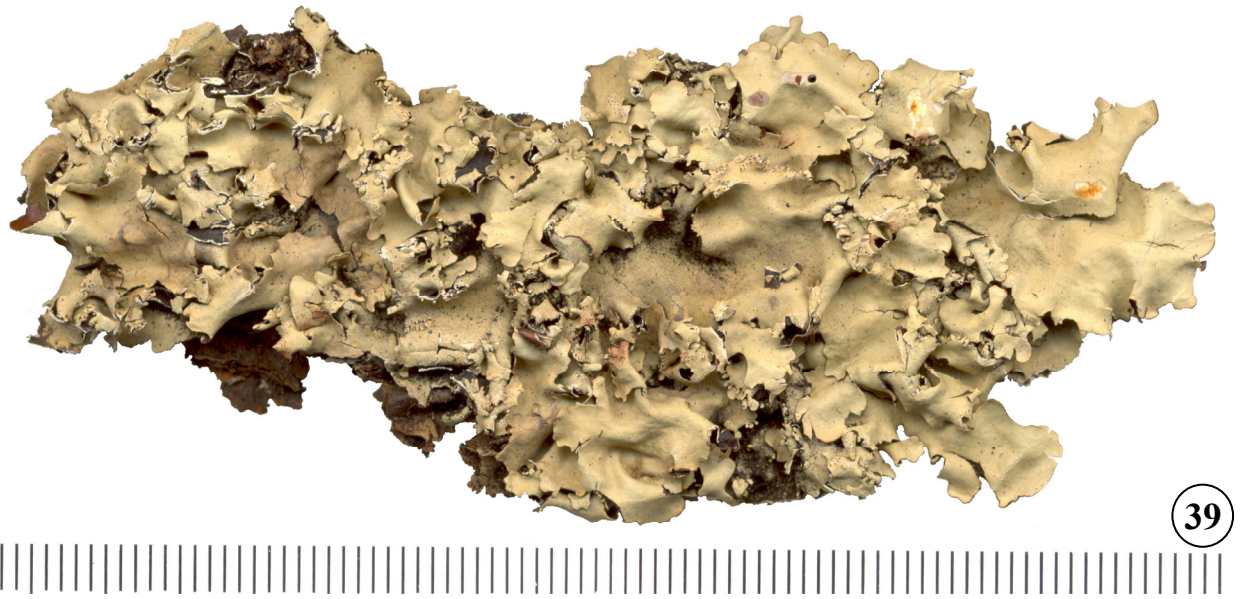
Figures 24-25: 24 – Part of the holotype of *Parmotrema expansum* (US); **25** – Holotype of *P. flavescens* (M). Scales in millimeters.

Figures 26-27: 26 – Holotype of *Parmotrema foliolosum* (FH); **27** – Holotype of *P. foliolosum*, showing the undersurface. Scales in millimeters.

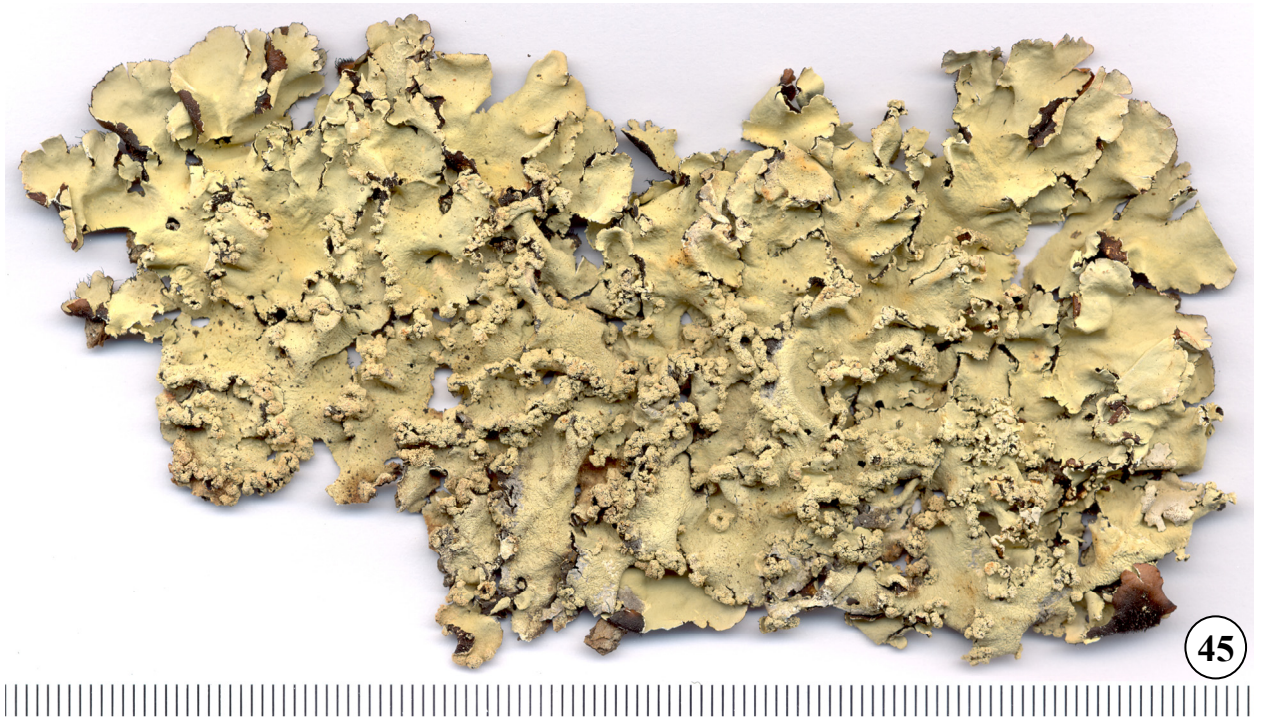
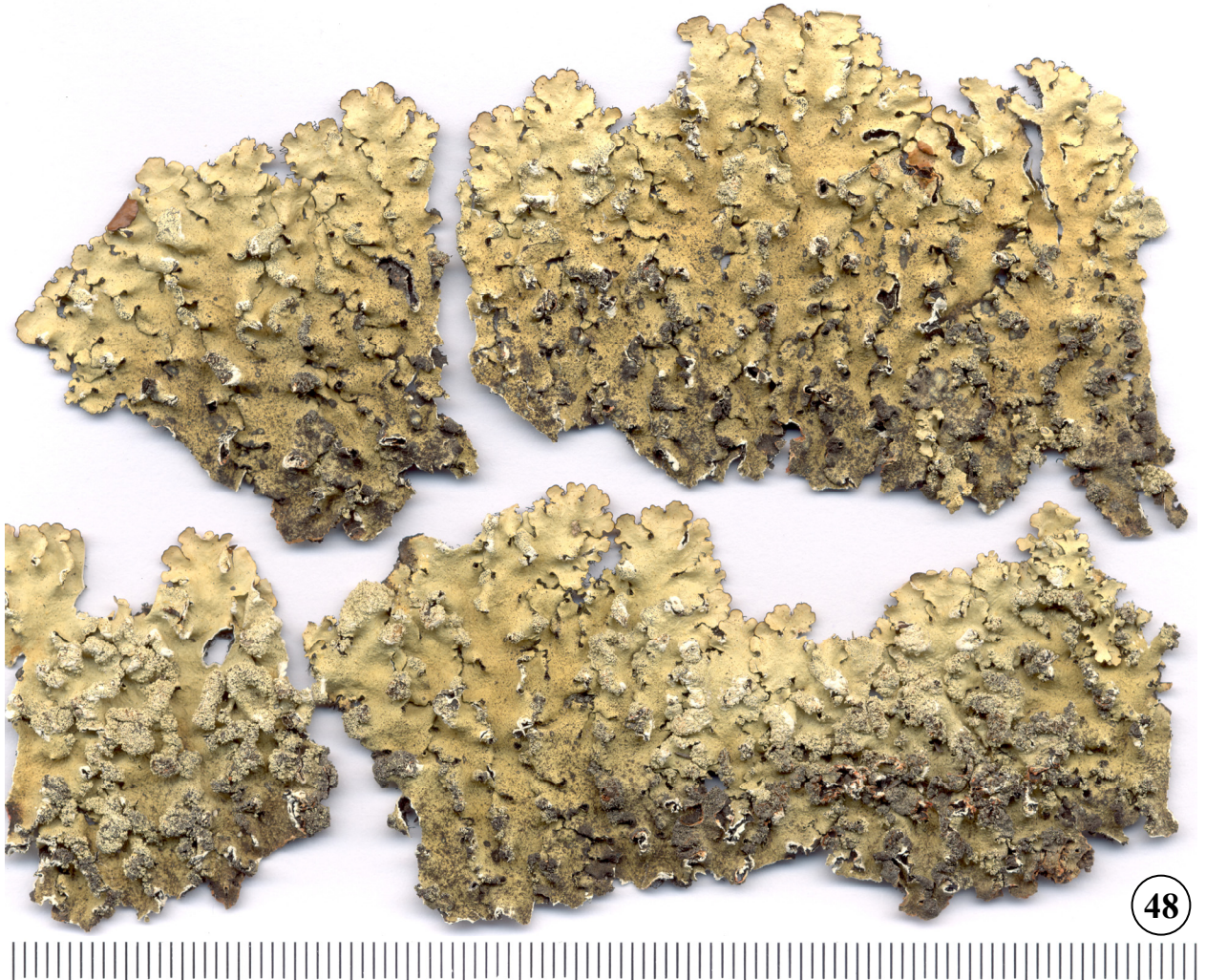
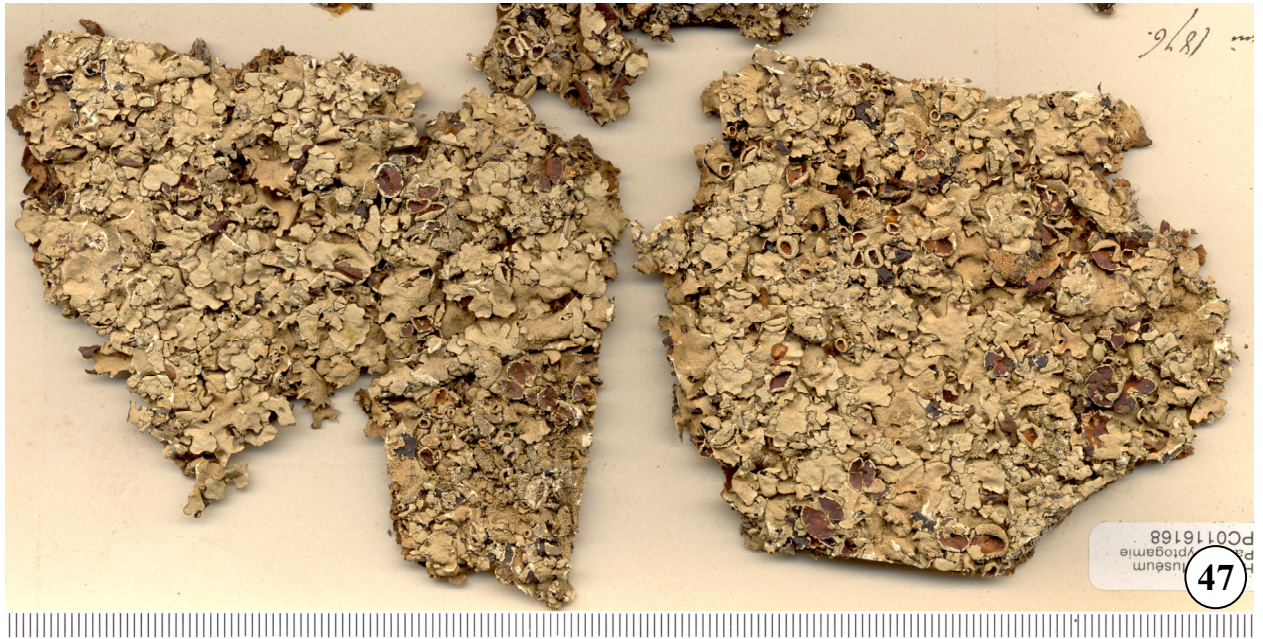
Figure 28: Holotype of *Parmotrema granulare* (TNS). Scale in millimeters.

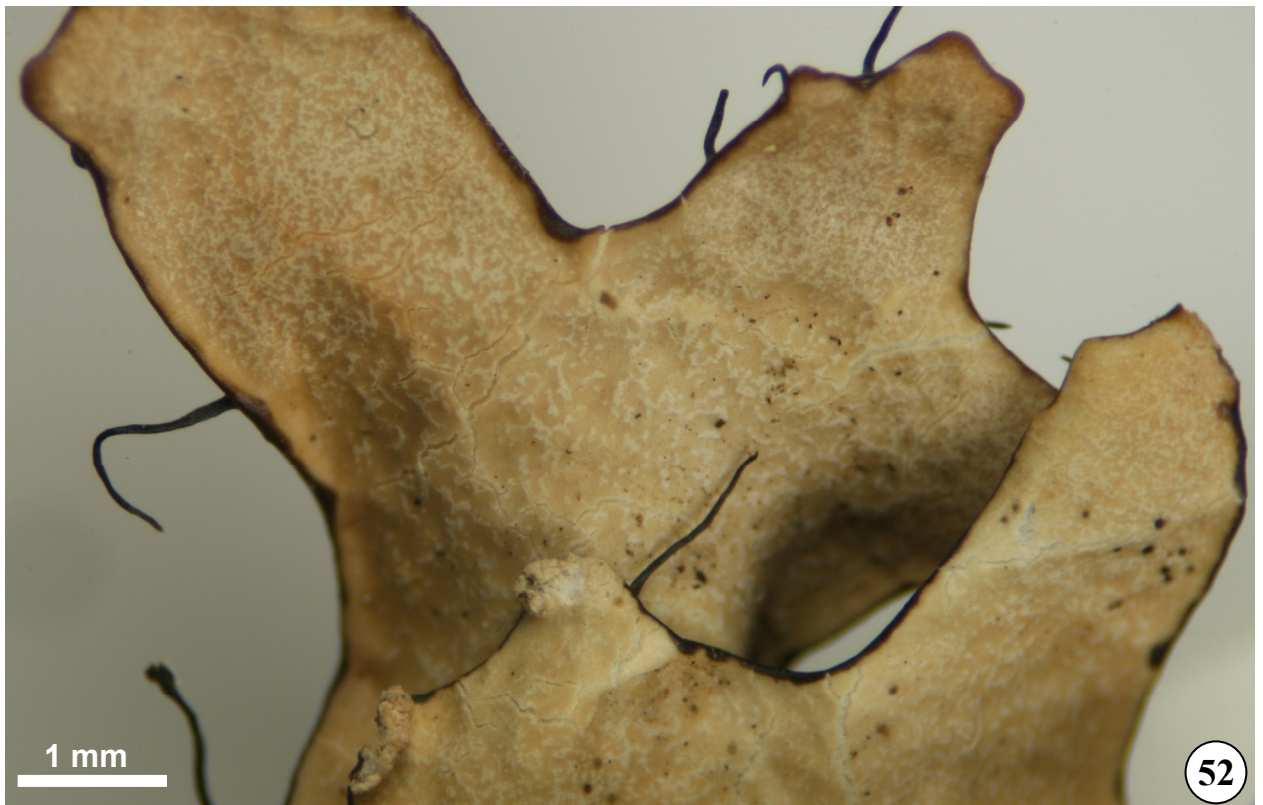
Figures 29-30: 29 – Holotype of *Parmotrema herrei* (FH); **30** – Holotype of *P. lacteum* (SP). Scales in millimeters.

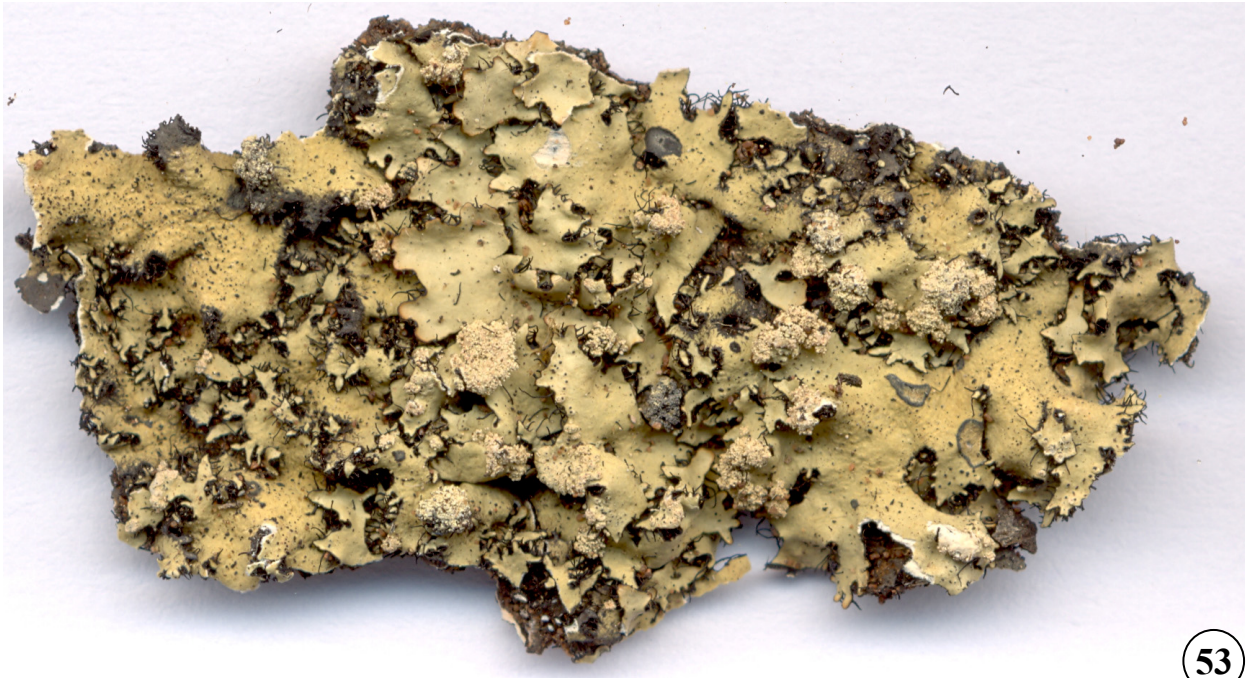
Figures 31-32: 31 – Lectotype of *Parmotrema latissimum* (G); **32** – Holotype of *P. leucosemothetum* (P). Scales in millimeters.

Figures 33-34: 33 – Holotype of *P leucosemothetum*, upper surface with strong effigurate maculae; **34** – Holotype of *P. leucosemothetum*, under marginal zone. Scales indicated.

Figures 35-36: 35 – Holotype of *Parmotrema lichexanthonicum* (UPCB); **36** – Lectotype of *P. livido-tesselatum* (P). Scales in millimeters.

Figures 37-38: 37 – Holotype of *Parmotrema magnum* (S); **38** – Isotype of *P. magnum* (LD), showing the rugose and lacerate apothecia. Scales in millimeters or as indicated.

Figures 39-40: 39 – Holotype of *Parmelia microdactyla* (UPS); **40** – Holotype of *P. microdactyla*, showing the lobules (arrows). Scales in millimeters.

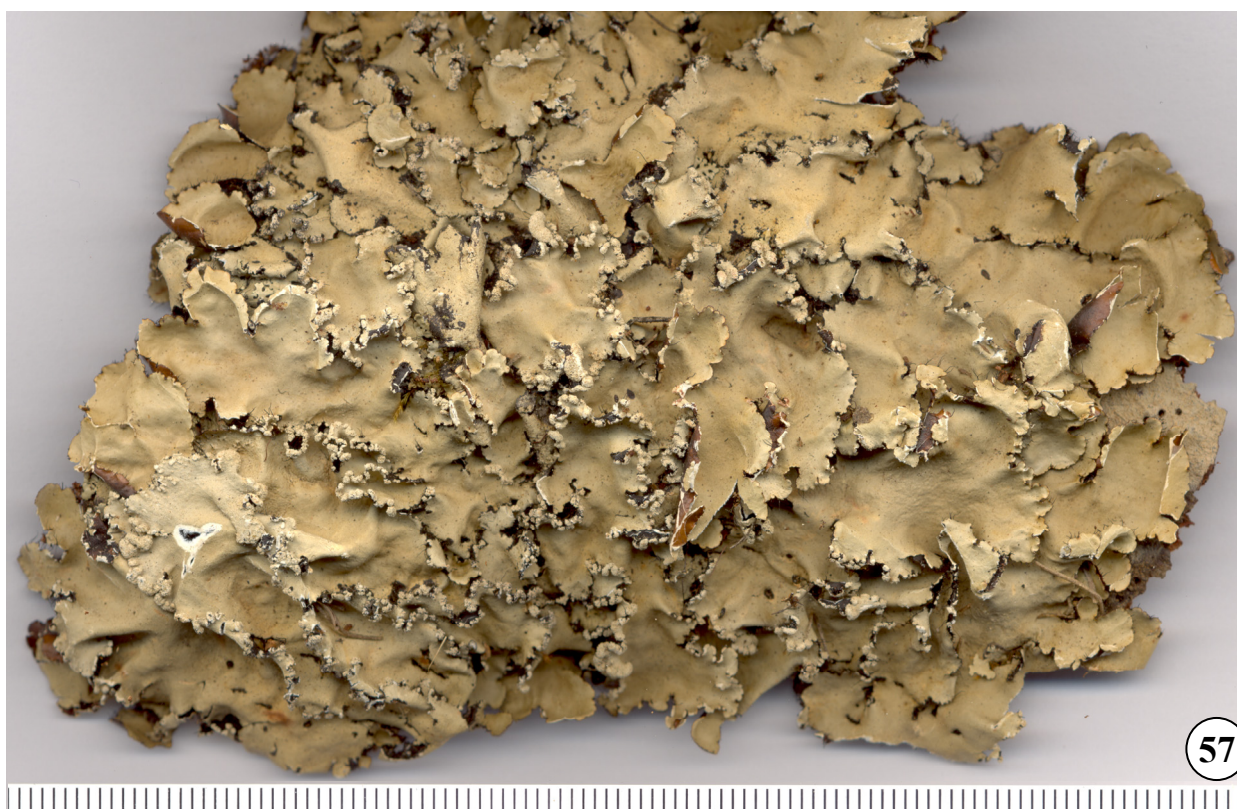
Figures 41-42: 41 – Isotype of *Parmotrema mantiqueirense* (US); **42** – Part of the lectotype of *P. margaritatum* (P). Scales in millimeters.

Figures 43-44: 43 – Holotype of *Parmotrema masonii* (CTES); **44** – Part of the holotype of *P. maximum* (P). Scales in millimeters.

Figures 45-46: 45 – Part of the holotype of *Parmotrema mirandum* (US); **46** – Holotype of *P. neotropicum* (US). Scales in millimeters.

Figures 47-48: 47 – Part of the holotype of *Parmotrema nudum* (P); **48** – Holotype of *P. nylanderi* (S). Scales in millimeters.

Figures 49-50: 49 – Holotype of *Parmotrema parahypotropum* (TNS); **50** – Holotype of *P. parahypotropum*, showing the soralia. Scales in millimeters, except as indicated.

Figures 51-52: 51 – Holotype of *Parmotrema paramoreliense* (DUKE); **52** – Holotype of *P. paramoreliense*, showing effigurate maculae and the black marginal line. Scales in millimeters, except as indicated.

54

Figures 53-54: 53 – Part of the holotype of *Parmotrema pectinatum* (SP); **54** – Holotype of *P. permaculatum* (US). Scales in millimeters.

Figures 55-56: 55 – Part of the holotype of *Parmotrema petropoliense* (W); **56** – Holotype of *P. petropoliense*, showing cilia and soralia. Scales in millimeters, except as indicated.

58

Figures 57-58: 57 – Holotype of *Parmotrema pontagrossense* (UPCB); **58** – Syntype of *P. pseudoreticulatum* (F). Scales in millimeters.

Figures 59-60: 59 – Lectotype of *Parmotrema radiatum* (S); **60** – Holotype of *P. ramusculum* (BM). Scales in millimeters.

62

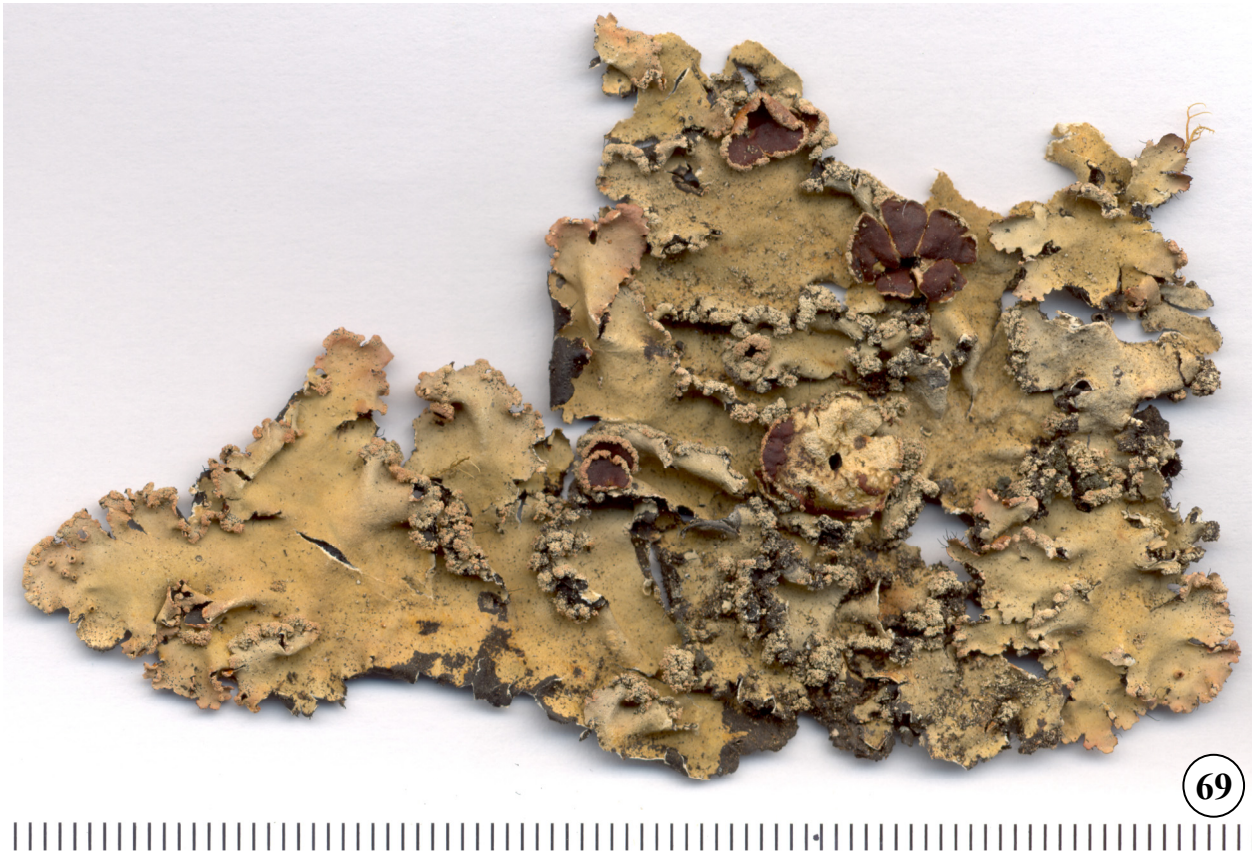
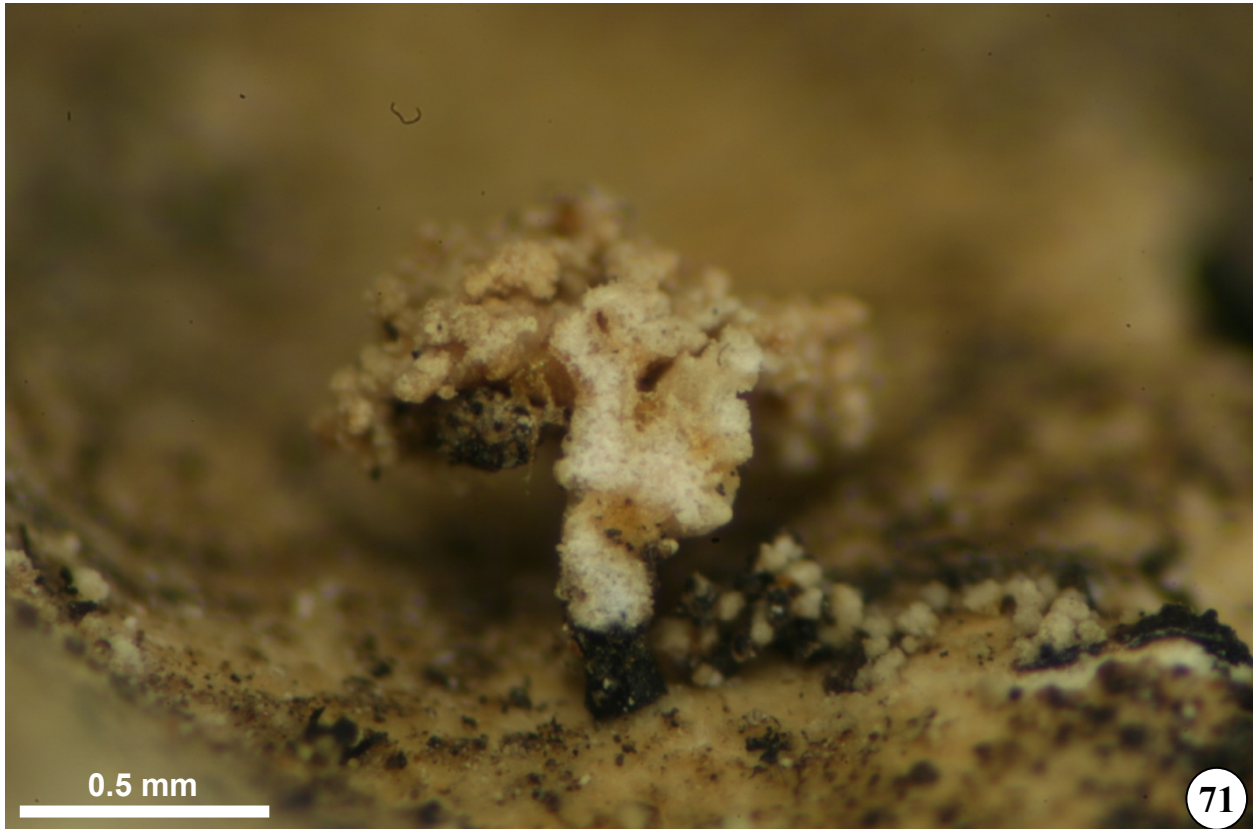
Figures 61-62: 61 – Holotype of *Parmotrema reitzii* (US); **62** – Holotype of *P. reitzii*, showing the undersurface. Scales in millimeters.

63

Figures 63-64: 63 – Lectotype of *Parmotrema reparatum* (BM); **64** – Holotype of *P. reterimulosum* (WU). Scales in millimeters.

Figures 65-66: 65 – Duplicate of the lectotype of *Parmotrema reticulatum* (BM); **66** – Lectotype of *P. ruminatum* (W). Scales in millimeters.

68

Figures 67-68: 67 – Holotype of *Parmotrema ruptum* (S); **68** – Part of the holotype of *P. sieberi* (FH). Scales in millimeters.

Figures 69-70: 69 – Holotype of *Parmotrema spinibarbe* (TNS); **70** – Holotype of *P. spinibarbe*, showing the cespitose cilia. Scales in millimeters, except as indicated.

Figures 71-72: 71 – Isotype of *Parmotrema spinibarbe* (G), showing the botryose structure; **72** – Holotype of *P. stuppeum* (FH). Scales in millimeters, except as indicated.

Figures 73-74: 73 – Holotype of *Parmotrema subcaperatum* (M); **74** – Lectotype of *P. subisidiosum* (G). Scales in millimeters.

Figures 75-76: 75 – Holotype of *Parmotrema subsumptum* (H-NYL); **76** – Holotype of *P. subtinctorium* (WU). Scales in millimeters.

Figures 77-79: 77 – Holotype of *Parmotrema ultralucens* (O); **78** – Holotype of *P. verrucisetosum* (B). **79** – Holotype of *P. verrucisetosum*, showing ciliate warts. Scales in millimeters, except as indicated.

Figure 80: Lectotype of *Parmotrema warmingii* (M). Scales in millimeters.

Figures 81-82: 81 – Lectotype of *Parmelia badia* (P); **82** – Holotype of *Parmelinella afrocetrata* (B). Scales in millimeters.